VOL. LXXXVII. No. 2231. | AUGUST 27, 1920. | PRICE SIXPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 6d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
Telegraphic Address: "Ageekay, Cent., London." A B C Code. Telephone Nos. City 997; Central 4425 (Editorial only).

All Rights Reserved.

Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage.

LITHOLITE INSULATORS, Ltd.
55—57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston, 692, London.
FIREPROOF AND OTHER GRADES.
ESTABLISHED NEARLY 20 YEARS.

Birkby's **"ELO"**
For all purposes for which moulded insulation is required specify "ELO"—which is water, oil and fireproof.
FLEMING, BIRKBY & PARRY, LTD., LIVERSEDGE, YORKSHIRE.

WRIGHT A.C. and D.C. **MOTORS.**
'Phone: 499 Tel.: Motor.
WRIGHT MOTORS, Ltd., HALIFAX.

EVERY DESCRIPTION OF
SMALL TURNED PARTS and CASTINGS for ELECTRICAL ENGINEERS.
A. MORTON,
6, Tenby Street North, Birmingham.

BROOK
ONE, TWO and THREE-PHASE
MOTORS.
See Sup. 54.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors,
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA & MICANITE
TAYLOR & PETTERS, LTD.,
40, Hatton Garden, London, E.C. 1.
'Phone: 4575 Central. See Page ii.

MOTORS. • DYNAMOS.
VICTORIA DYNAMO & MOTOR CO.,
CRAVEN HOUSE,
Kingsway, London, W.C. 2.
'Phone: Gerrard 1245.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

SKATOSKALO BOILER SCALING TOOLS.
Sole Maker:
FRANK GILMAN,
9, Westfield Road, BIRMINGHAM.
See Advertisement this week, page xxxvii.

"EMPIRE"
AUTOMATIC CONTROL
FOR
Pumps, Compressors, Machine Tools.
ELECTRIC CONTROL, LIMITED, GLASGOW.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C. 2
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement last week, p. xvi.

CONNOLLY'S (BLACKLEY), Ld.,
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST., CLERKENWELL, LONDON, E.C. 1.
Wire Voltograph, London. 'Phone: City, 8660.

ELECTRIC MOTORS.
One, Two and Three-Phase.
BRITTAIN'S ELECTRIC MOTOR Co.
(Late Langdon-Davies Electric Motor Co.),
110, Cannon Street, London, E.C. 4.

INSULATING -- BEADS --
Immediate Delivery.
HOLDER-HARRIDEN LTD., 35/37, Noble St., London, E.C.

The Making of V.I.R. Cables.
See page xiii.

Better than Rawour, Leather and Gutta-Percha.
PACKING RINGS.
DERMATINE
DERMATINE CO., Ltd.,
Neate St., London, S.E. 5

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
REPAIRS TO ANY MAKE **MOTOR STARTERS.**
THE SOLENOID REGULATOR CO.,
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 582. **BIRMINGHAM.** Telegrams: 'Solenoid, Birmingham.'

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

ELECTRIC MOTOR REPAIRS.
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON, S.E. 1

RAYNER & HEALD, LTD.,
DUKE STREET, DERBY.
TWO & THREE-PHASE MOTORS only.
See page xxxv.

FULLER'S UNITED ELECTRIC WORKS, LIMITED,
MANUFACTURERS OF
ACCUMULATORS BATTERIES
WIRES & CABLES CARBONS, &c.
WORKS: CHADWELL HEATH, ESSEX.
General Sales Offices:
IDDESLEIGH HOUSE, Caxton St., Westminster.
'Grams Bioshot, Vic. London. 'Phone: Victoria 6845.

INGLEBY & CO.,
ELLAND ROAD, LTD.
MOTORS LEEDS.
FOR DIRECT AND ALTERNATING CURRENT Tel. 378.
Delivery from Stock up to 50 H.P.

Advertisement Index, see page xxxvi

GENERAL LIBRARY SEP 1 1920 UNIV. OF MICH.

ENGLISH
EDISWAN
EVERYTHING
ELECTRICAL

The house of Ediswan is the best equipped to deal with all enquiries for
Everything
Electrical.
ENTIRELY BRITISH.

The Edison Swan Electric Co., Ltd.
PONDERS END, MIDDLESEX.
London and Provincial Depots.

BERRY'S
HIGH-TENSION
BOX COMPOUND.
Fulfils all requirements.

PREMIER BITUMEN & ASPHALTE CO., LTD.,
STRATFORD MARKET, E. 15.

NO CAR LIGHTING
SET COMPLETE
WITHOUT
THIS

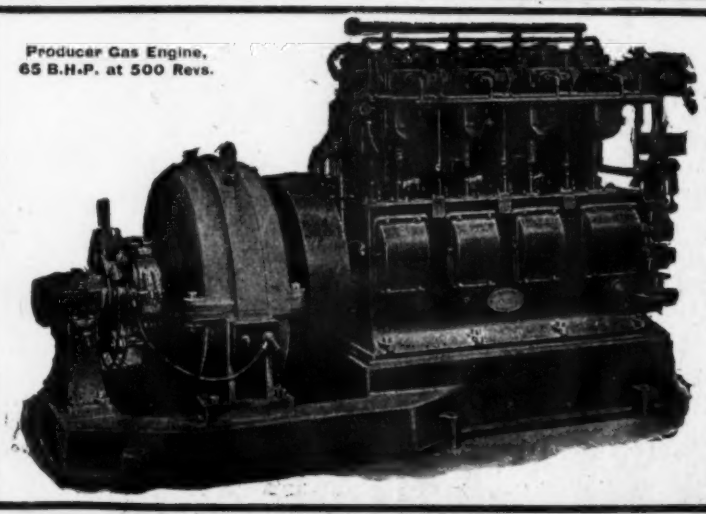
Price Right.
Delivery Prompt.

R. B. HAND & Co.,
LTD.,
63, High Holborn,
LONDON, W.C. 1.
'Phone Museum 6286.

MICA & MICANITE
INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
Contractors for Air Board, War Office and Admiralty Requirements.
CUTTING AND GAUGING OUR SPECIALITY.
BEST QUALITY MICA ONLY.

'PHONE—4575 CENTRAL.
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C. 1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.

Producer Gas Engine,
65 B.H.P. at 500 Revs.



Telegraphic Address:—"THEOREM, PATRICROFT."
GARDNER
Gas and Oil Engines
Vertical High-Speed Type for coupling direct to Dynamos.
From 5 B.H.P. to 120 B.H.P.

L. GARDNER & SONS, Ltd.,
Barton Hill Engine Works,
PATRICROFT, MANCHESTER.

NORRIS, HENTY & GARDNER'S, Ltd.,
GARDNER HOUSE,
115, Queen Victoria Street, London, E.C. 4.
Telephone Nos. 9493 & 9494 City.
Telegraphic Address: { NORNODERZE, CANNON, LONDON (charged as two words only).
Glasgow Showroom: 24, ST. VINCENT ST.

Telephone: CITY 3115. Telegrams: "VANDUARA, CENT, LONDON."
Contractors to H.M. Government.
ELECTRICAL INSULATING TAPES, WEBS, CORDS, SLEEVING, &c.
DELIVERY FROM STOCK.
JOHN MACLENNAN & CO.,
115, NEWGATE STREET, LONDON, E.C. 1, AND AT 186, INGRAM STREET, GLASGOW.

THE

ELECTRICAL REVIEW.

VOL. LXXXVII. AUGUST 27, 1920. No. 2,231.

ELECTRICAL REVIEW.

Vol. LXXXVII.] CONTENTS: August 27, 1920. [No. 2,231.

	Page
The Strike Fever	257
The Work of the Electricity Commissioners	258
The B.A. at Cardiff	259
"Science and the Public"	259
The Minimum Charge Restored	259
Extensions at Aylesbury (*illus.*)	260
Messrs. Debenhams' Electric Restaurant (*illus.*)	262
The British Standard Cooking Range	263
The British Association.—I.	264
Engineering Section	265
Mathematical and Physical Science Section	266
Industrial Psychology, by E. S. Hodgson	266
Electricity Supply in the United Kingdom	267
Correspondence—	
Electricity Supply Restrictions	267
Tests for Electric Welds	267
Power Factor, by C. Turnbull	268
Legal	269
Business Notes	270
Notes	275
City Notes	279
Stocks and Shares	279
Market Quotations	280
Electrical Conditions in Holland	281
Extra Long-Distance Transmission of Electrical Energy (*continued*)	282
Alternating Current Track Circuiting, by L. H. Peter (*illus.*) (*concluded*)	283
Reviews	284
New Electrical Devices, Fittings and Plant (*illus.*)	286
Electricity Supply at Paris	287
New Patents Applied for, 1920	287
Abstracts of Published Specifications	288
Contractors' Column	Advertisement page xxv

"ELECTRICAL REVIEW" SUBSCRIPTION RATES.

UNITED KINGDOM	***£1 14 8 per annum.***
CANADA	***1 12 6 do.***
COLONIAL and FOREIGN	***2 1 6 do.***

Postage Free.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 6d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEKRAY, CENT., LONDON." Code, A B C. Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c. Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 123, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London City and Midland Bank, Newgate Street Branch."

THE STRIKE FEVER.

THE grave situation which has arisen out of the electricians' strike at Messrs. Cammell, Laird & Co.'s works at Penistone, is attracting general attention, as it may lead to a complete stoppage of the engineering industries. Briefly, the position is this: An electrician at the works was promoted to the office of foreman, and resigned his membership of the Electrical Trades Union. The latter demanded that he should rejoin the Union, or be dismissed, but the foreman and his employers respectively declined to accede to these demands, and the E.T.U. declared a strike, which has now been in progress for about seven weeks. On the appeal of the company for support, the Engineering and National Employers' Federation took up the matter and opened negotiations with the Union, but the latter maintained its uncompromising attitude, claiming that in future all foremen over electricians should be members of the Union, and as this involved an important question of principle which the Employers' Federation could not concede, a deadlock resulted. As the dispute affected other Unions, notably the Amalgamated Engineering Union, the Iron and Steel Trades Confederation, and the National Federation of General Workers, conferences were held between them and the employers, in the hope of bringing about a settlement, but without success, and the Employers' Federation decided to issue notices to the effect that they would not employ any members of the E.T.U. These notices were to have been issued on Monday last, but action was postponed until to-morrow, the notices to expire on the first Saturday in September. A meeting of the Executive Committee of the E.T.U. was held on Tuesday at Manchester to consider the situation. On Friday last the National Federation of General Workers, of which many members will be affected by a general strike or lockout of members of the E.T.U., at its annual conference expressed regret that its member Unions had not been consulted by the E.T.U. before action was taken, and decided to call a conference of the Executives of the Unions to discuss the matter.

The question at issue is no new one; only recently it led to a law suit (Hodges *v.* Webb), and it has repeatedly been the subject of local strikes. Now, however, it has assumed still greater importance, owing to its having become national in character, and it is desirable to consider exactly what it means.

In the first place, it should be clearly realised that if an agreement is not quickly reached, an immense amount of damage will surely be inflicted upon the nation at large. As electricity is the handmaid of all other engineering industries, it follows that the latter will be brought to a standstill by a strike or lock-out, and that at least half a million men belonging to other Unions will be thrown out of work. Those other Unions are by no means pleased with the prospect, and the secretary of the National Federation of General Workers, Mr. J. O'Grady, M.P., has expressed himself forcibly on the subject; he says:—"It is high time that this damned nonsense was stopped. Over and over again we have had thousands of our members thrown out of employment through disputes about which we have not been consulted. . . . On the merits of the dispute, we hold the view that the policy of the Electrical Trades Union is wrong.

Secondly, it should be understood that the claim of the Electrical Trades Union that foremen should necessarily be members of the Union is not in accordance with Trade-Union practice. On this point we may quote Mr. G. N. Barnes, M.P., formerly general secretary to the A.S.E., as reported in the *Evening Standard*; Mr. Barnes said that the A.S.E. had never made such a demand as that put forward by the E.T.U. The National Association of Supervising Electricians, a Trade Union embracing a large number of foremen in its membership, is strenuously opposed to the claim, which, it maintains, would render the life of a foreman unendurable.

Lastly, let us understand the inner significance of the movement. It is the avowed policy of the Electrical Trades Union to compel first foremen, and ultimately managers, of electrical firms to become members of the Union, with a view to securing complete control of the industry. That is a policy which naturally cannot be tolerated by the employers. It is indistinguishable from the policy which has brought ruin upon Russia, in the shape of the worst form of tyranny, violating the fundamental principles of democracy, and destroying the last remnants of personal liberty. So long as this policy is pursued by the Electrical Trades Union, so long will the electrical industry—and the countless industries which depend upon its operations—be harassed and perplexed, and deprived of the opportunity for peaceful development and increased production which is the key to future prosperity.

We do not believe that the rank and file of the E.T.U. are in sympathy with, or responsible for, the policy adopted by their hot-headed leaders; it is certain that other Trade Unions regard it with strong disapproval. According to *The Times* of Monday last, Mr. Frank Smith, secretary of the Engineering and Shipbuilding Trades Federation, which is likely to be involved, on Saturday earnestly appealed for industrial stability; he said: "I am convinced that neither side wants to fight. Industry is going to pass through a great trial during the winter and the early spring, and all the evidence we can collect indicates that unemployment will increase. But we have no evidence that employers want a slump in the shipbuilding and engineering trades, and given 12 months' stability—a period free from the threat of striking or any menace of lock-out or unemployment—I believe we should pull through." He hoped that the Trade Union Congress next month would "take a firm stand and discourage this policy of strike action which is affecting us all."

We hope so, too; the last thing we could wish for is a stoppage of work, especially at such a time of difficulty and uncertainty as the present. But we prize liberty above all other blessings, and, if that can be safeguarded by no other means, we regretfully conclude that a struggle is unavoidable.

Would that this were the only dispute that threatened disturbance to the electrical and engineering industries! Unfortunately, a far greater calamity looms ahead in the shape of the miners' further effort towards the nationalisation of the coal mines, the ballot for which is now in progress. The disastrous consequences to the whole nation of such a strike need no demonstration; there is not one of us who would not suffer, and those who would suffer most are also those least able to bear the strain—the workers in other industries, who, at the will of the miners, would be thrown idle, deprived of coal and gas, and quickly reduced to famine, for the sake of a cause in which they have nothing to gain, but a great deal to lose. The crafty attempt of the miners' leaders to make the strike appear to be in the public interest by combining with their claim for increased wages a demand for a reduction in the price of coal is a masterpiece of hypocrisy; the stoppage of our exports of coal would not only throw a greatly increased burden on taxation, it would also cut off the inflow of goods to pay for those exports, lower the exchange, and increase the price of all imported foodstuffs. The miners' policy is dictated by crazy folly; their demands cannot possibly be conceded, and it will take weeks of misery and months of hardship, imposed upon the whole country, to demonstrate that obvious fact.

The Work of the Electricity Commissioners.

Although the five members of the Electricity Commission were only appointed eight months ago, they have in that comparatively short period of time managed to get through a considerable amount of work. The scope and importance of the work that has been brought to successful fruition this year is not readily apparent to those who have not followed closely the Commissioners' activities. The report of the Minister of Transport respecting the proceedings of the Ministry under the Electricity (Supply) Acts, 1882 to 1919, during the past year is, therefore, worthy of notice.

From the abstract of the report which will be found elsewhere in this issue, it will be seen that the preliminary survey of the present and prospective electrical requirements of the greater part of the country, which led to the provisional determination of seven electricity districts, embraced other districts of great importance from the point of view of electricity supply; numerous conferences were held, and much time and thought was given to the problems involved in the improvement of existing organisations. Before formal or provisional consent could be given in the case of applications for consent to the establishment of new, or the extension of existing, generating stations, the Commissioners had to satisfy themselves that the need was urgent, that the proposals were technically sound, and that there was no economical alternative source of supply available at the moment or in the immediate future. This was no light task, and it is gratifying to learn that in the majority of applications a good case was made out for the works or plant in question. The need for increasing the output of electricity in certain districts is, at the moment, very real and urgent.

Another point that will occasion general satisfaction is that in the few cases where proposals have been submitted for the establishment of new private generating stations, the Commissioners have prescribed regulations governing the type of current, frequency, and pressure to be used with a view to the standardisation of electricity supply in the districts concerned. This is in conformity with the policy followed in dealing with applications for permission to extend existing stations, which for the most part relate to plant only, and not to buildings, and has been governed by considerations of the necessity of facilitating the development of the electrical industry in any district; the effect of any given extension upon the ultimate development of electricity supply in the district; and the undesirability of extending a badly-placed station in one district when a better situated station in an adjoining district could be extended, and thus enabled to assist the first-named station.

It will be noted that the Commissioners have, on the application of certain authorised undertakers, consented to such applicants subscribing to the I.M.E.A., the B.E.S.A., and the E.D.A. This decision was made possible by Sec. 30 of the Act of 1919, and will result in nothing but benefit to all concerned. It may also be pointed out that Sec. 30 enables undertakers to send delegates to conferences, meetings, exhibitions, &c., which they were unable to do under the conditions prevailing in the past.

The Minister of Transport draws attention in the Report to the fact that "the fund out of which the expenses of the Commissioners are defrayed will be provided by contributions levied upon the industry (although temporarily financed by advances from the Exchequer.)" This comes under Sec. 29 of last year's Act, where it provides that for the first two years the Commissioners can borrow from the Treasury. Thereafter, over the next three years, repayment is to be made by equal annual instalments. The undertakings, of course, will have jointly to find this money, on the basis provided in the Act, namely, proportionately to the units generated. One thing certainly seems sure in this connection, namely, that the Commissioners are running the Department with scrupulous economy. Gwydyr House, despite its archæological prestige, is by no means palatial. Its appointments are modesty itself. One might almost think it the home of an ascetic order vowed to poverty, obedience, and—of course—chastity. Anyhow, undertakings may take comfort to themselves that there is no reckless expenditure going on. Further, no one could say that the

Department was over-staffed. Altogether, if things go on as they are going, the electricity supply undertakings stand to get exceptional value for any contribution they are ultimately asked to make.

In conclusion, the Electricity Commissioners are to be congratulated upon the success with which their initial efforts have been crowned. The formation of Joint Electricity Authorities in various parts of the country is progressing satisfactorily, and it is to be hoped that the success so far achieved in directing the reorganisation of existing sources of supply, and in supervising the initiation of new ones, will continue in connection with future proceedings.

The B.A. at Cardiff.

The British Association is to be condoled with on the unfortunate coincidence of its meeting at Cardiff and the strike of Corporation employés, which cannot fail to interfere with the comfort and convenience of the members to a marked degree. To this circumstance, combined with the high cost of railway travelling, is the small attendance doubtless to be attributed; instead of the usual number of 1,500 to 2,000 members, fewer than 1,000 are present, and the attendance at some of the Sections is very scanty. Admirable arrangements had been made by the local organising committee for the accommodation of the various Sections, and a full programme of papers and discussions was provided, covering a wide range of subjects; on this occasion, however, there appears to be a comparatively small proportion of matter likely to be of direct interest to the electrical industries.

We give elsewhere abstracts of two of the Presidential addresses. That of Prof. C. F. Jenkin is noteworthy in that it directs attention to the lamentable deficiencies which still exist, in spite of the vast amount of research that has been carried out, in our knowledge of the properties of materials used in the engineering industries, with the result that we are still compelled to cover up our ignorance by the use of large factors of safety. As in other departments of science, we are only now learning to realise the enormous importance of small causes from which great effects arise; the strength of a steel shaft, for instance, may be appreciably affected by producing a high polish on its surface, instead of leaving it scored with infinitesimal scratches resulting from the use of abrasive polishing materials.

On the other hand, we pass to the opposite extreme in the address of Prof. Eddington, who showed how science could penetrate into the interior of the "giant stars," consisting of incandescent gas—situated at distances so great that light has taken 100,000 years to pass from them to us—and gather from these "borings" information regarding the constitution of the atoms themselves. It is interesting to note that the observations thus made tend to confirm the theories with regard to the constitution of matter which have gained acceptance during this century, and that no phenomenon conflicting with those theories has yet been observed.

"Science and the Public."

This is the heading of a leaderette in the *Daily Mail*, which states that "Light is to be 'caught bending' next week at Cardiff." It goes on to say that "We have in Britain to-day as original a group of scientific men as any country in the world; and they are beginning at last to see the wisdom of coming out of their caves and laboratories and applying their brains to practical affairs; to the laws that govern heredity, to wireless apparatus, to the uses of alcohol, to the migration of fish, to medicinal thought-reading, to the possibilities of intensive cultivation—which bulks largely this year—indeed to scores of practical themes to which their more abstract studies are leading.

"In any case, it is time most profitably spent if for one week in the year our men of science bend their united energies to the work of interesting the public in the advance of science. It is as much the duty of the public to appreciate the men of science as of men of science to come to meet the public."

Now, what does the *Daily Mail* think "our men of science" had been doing during the period before they began to see the wisdom of coming out of their caves and applying their brains to practical affairs? Does it really think that they have suddenly awakened and hurriedly worked up papers on the laws of heredity, on wireless apparatus, &c., just for the purpose of interesting the public during this British Association week?

The *Mail* speaks of "our men of science" with a patronising air, a kindly condescension which implies that they are rather weird uncanny folk, not quite normal, who dwell in "caves and laboratories," and do not usually apply their brains to practical affairs—so unlike the brainy trumpeters of the daily Press, who gaily talk of "catching light bending" without having the faintest conception of the significance of the allusion. This superior attitude of the journalist who, in many cases, cannot even write English correctly, and whose mind is blankly opaque to the most elementary notions of physical science, is galling to those who are able to appreciate the nature and value of the work of that band of British scientific heroes, without whose efforts, the result of long years of patient training in research, the war would inevitably have been lost, on the land, on the sea, and in the air. If the lay Press would descend from its wooden pedestal and inculcate in the public mind that knowledge and love of science through which "our men of science"—unexcelled in the whole world—acquired their equipment for winning the war, instead of perpetuating the silly and antiquated notion that they are habitually immersed in useless hobbies of no practical utility, it would do real service to the country.

The Minimum Charge Restored.

Up to the present the minimum charge has been under a ban. For some time past the Board of Trade, when granting an increase of statutory price, has taken the opportunity afforded by the application made by the supply undertaking, to cut out the minimum charge The main motive was to act consistently with the other Government departments which in war-time were preaching economy and exhorting all and sundry to decrease their use of electricity. Now, however, when consumers can again be as prodigal as they like in such use, this reason vanishes, and the Electricity Commissioners, giving heed to the woes of small electricity undertakings, are once more inserting the minimum charge in orders. Of course, throughout the whole time, the minimum charges existing in orders which were not brought to the Board of Trade for review still continued operative; so it was only the undertakings which were unfortunate enough not to make their undertakings pay, and which were thus compelled to have recourse to the Board of Trade, which were thus mulcted—obviously an anomaly, although, in the circumstances, unavoidable. However, the paternal benevolence of the Commissioners has seemingly been touched, and in some new orders, at any rate, the minimum charge is reappearing.

There is a change, however, in the method. Previously the minimum charge was 20 units per quarter for all quarters alike. This is now being changed to 15 units for the winter quarters, and 10 units for the summer quarters. This is a substantial reduction, of course, but it has to be borne in mind that a greatly increased charge per unit is now in vogue, so that monetarily the present charge is not so discrepant with the old charge as appears at first sight. There is, of course, still an anomaly, namely, the case of undertakings which have lost their minimum charges on recent orders. These, unfortunately, cannot regain their minimum until such time as they are entitled to make a further application for a revision of charges. Those which have received increases under the Statutory Undertakings Increase of Charges Act can, however, apparently make further application forthwith—if their individual circumstances warrant it.

EXTENSIONS AT AYLESBURY.

The first Local Government Board inquiry into the Council's application to borrow £21,323 for the purpose of erecting the borough electricity supply works was held in May, 1914. The initial plant installed consisted of two sets of vertical, three-line, Willans-Diesel oil engines direct-coupled to 100-kw. E.C.C. generators, together with a 600-ampere-hour battery.

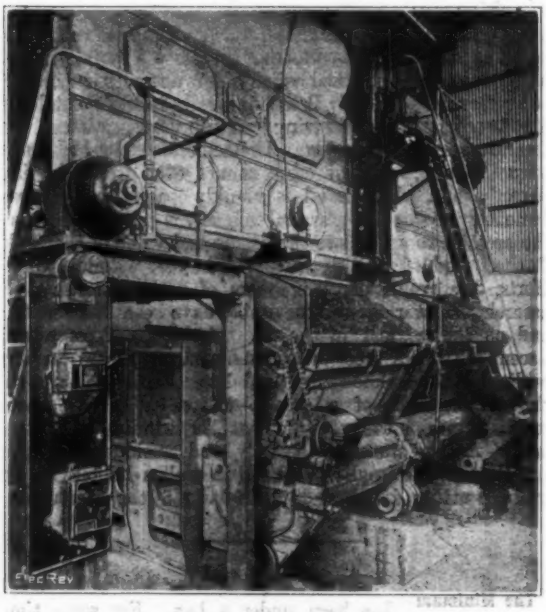


Fig. 1.—Stirling 20,000-lb. Boilers.

The public supply of electricity commenced in May, 1915; a large number of consumers was connected to the mains, and the manufacture of munitions of war led to a demand for considerable quantities of electricity. By the end of 1916 the battery had been enlarged by an additional 50 per cent. capacity, but by this time the demand from the munition factories had increased to such an extent that it became imperative to further extend the generating-station plant. A Premier horizontal four-cylinder, suction-gas engine direct coupled to a G.E.C. 200-kw. generator, which was provided with a static balancer, was, therefore, put into operation in January, 1918. This extension, which we described at the time*, was found to be insufficient to meet the rapidly-growing demand, but for various reasons brought about by the war, further plant could not be installed at that time.

It may be of interest to recall that Aylesbury was the first Diesel engine station to start, in August, 1916, the use of tar oil (creosote) as a fuel, and up to February, 1918, £996 was saved on the fuel bill by so doing. Later, by the use of anthracite peas in the gas plant, a consumption of 1·2 lb. (1·5 lb. average) per kw.-hour was shown in favour of the gas engine. This was a saving of 0·2d. per unit, and at that time represented a saving on the fuel bill of about £500 per annum; the figure would have been still greater if a large amount of the output had not to be made up by the use of the Diesel engines.

Following the Armistice, the Government gave sanction for further extensions to be proceeded with, and tenders were received for a 400-kw. gas engine set. In January, 1919, however, an application for a large amount of power swayed the decision in favour of a steam installation. This was officially inaugurated on August 5th by the Mayoress in the presence of a representative gathering.

The generating station is conveniently situated near the centre of the town, by the side of the canal, which supplies the necessary cooling water, and will facilitate the convenient handling of fuel from barges. Two Stirling boilers of the five-drum type have been installed, each as a single and independent unit, having a heating surface of 5,800 sq. ft., and working at a pressure of 200 lb. per sq. in. The boilers, fig. 1, are each capable of evaporating 20,000 lb. of water per hour; superheaters are fitted to each boiler capable of imparting a final temperature of 650° F. to the steam. One boiler is fitted with two Babcock & Wilcox chain-grate stokers, the other will be fitted with chain-grate stokers by the Underfeed Stoker Co. In addition to the coal-firing machinery, oil-firing accessories are being fitted, as a stand-by in cases of emergency, which will deal with any kind of crude oils. The fuel-burning arrangement is so designed that practically any type of fuel, from anthracite to a poor quality of bituminous slack, can be handled.

The feed-pumps are of the double-acting type, by Messrs. Weir, each pump being capable of supplying the two boilers on full load; they take their supply of water from an adjacent hot well, which is in turn fed from three sources: first, from the condensed steam from the turbine condenser; secondly, from the old cooling water tank, this being an emergency supply controlled by a ball valve placed in the hot well; and, lastly, from the Paterson water softener. The canal water has a hardness of 24°; it is softened by the addition of soda ash and lime to a hardness of 3½°.

There are two steel chimneys, each boiler being supplied with its independent draught system. Sirocco fans, driven by variable-speed 30-h.p. motors, supply the necessary draught for the fires.

The steam is led from the boilers to the turbine through a 5-in. solid-drawn steel pipe, which is fitted with two Sentinel steam traps and a centrifugal water separator. The turbo-generator, by the British Thomson-Houston Co., Ltd., is of the Curtis type, having three compound

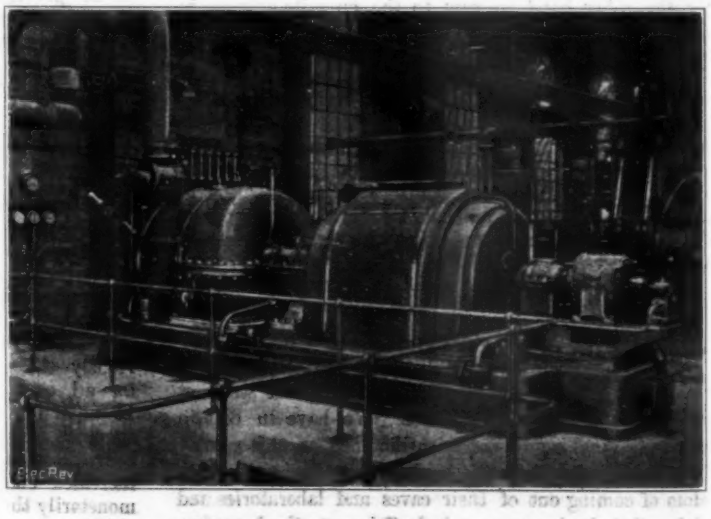


Fig. 2.—A B.T.H. Turbo-Generator Set at Aylesbury.

impulse stages. Although the steam is supplied at 200 lb. pressure, it is reduced to about 50 lb. before it reaches the turbine blades by being passed through contracting orifices. In addition to the usual fittings, the turbine is provided with a speed-limiting device to cut off the

*Electrical Review, April 19th, 1918; pp. 365-6.

steam supply should the normal speed of 3,000 R.P.M. be exceeded by 10 per cent. Should the lubricating oil pressure fail, the steam would also be cut off. The governor controls the speed within ½ per cent. for normal charges of load. The turbine, fig. 2, is rated at 1,000 KW., or with a 25 per cent. overload, which can be safely carried for a period of one hour, it is capable of giving an output of 1,600 H.P.

The condenser, by Messrs. Cole, Marchent & Morley, is placed in the basement immediately below the turbine, and is of the contraflow type; it has a cooling surface of 1,600 sq. ft., and is capable of giving a vacuum of 28½ in. with the barometer at 30 in.

The three Edwards air-pumps are driven by a 9-H.P. electric motor through gear-wheels, and run at 120 R.P.M. The circulating pump delivers 82,000 gallons of cooling water per hour through the condenser, and is driven by a 14-H.P. motor. The cooling water is drawn from the canal through a set of straining grids connected to an 18-in. cast-iron pipe; the pipe has branches placed in position to supply three future turbo-generators, and is designed to take a supply of water from the mill stream should the cooling capacity of the canal be insufficient. The discharge from the condenser is delivered into the canal basin.

The alternator is of the revolving-field, totally-enclosed

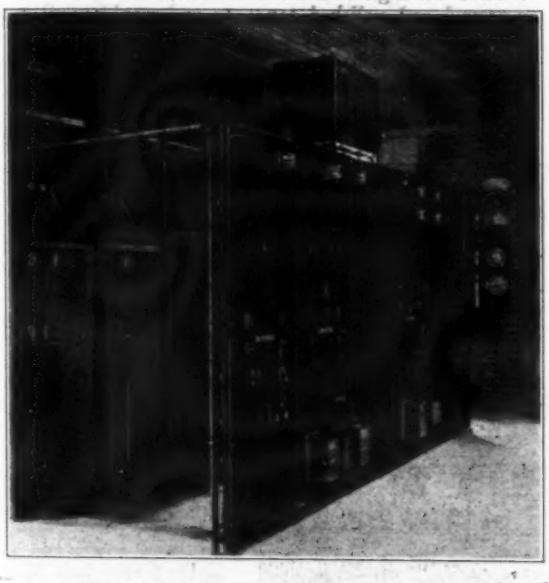


FIG. 3.—NEW SWITCHBOARD AND CUBICLES.

type with a D.C. exciter mounted on the turbine shaft. The stator core is made of transformer iron, built up in sections insulated from one another to reduce eddy currents to a minimum. The alternator is ventilated by a fan attached to the rotor, and receives air from a wet air filter placed in the basement; the air discharge takes place at the top of the stator frame. The alternator generates three-phase current at a pressure of 6,600 volts, which is led through a wire-armoured, lead-covered, and paper-insulated three-core conductor to the cubicle-room.

The cubicles, fig. 3, are built up of concrete slabs, and house the H.T. switchgear and instrument transformers. The operating board consists of black enamelled slate, upon which the operating handles, indicating and integrating instruments, and meters are fixed. The Tirrill regulator automatically regulates the voltage as the load varies within 1 per cent. of normal, thus obviating the constant attention of the switchboard attendant. A modern system of protective gear is installed to safeguard the alternator and auxiliaries from damage in the event of overloads, earths, and short circuits. A 500-KW. reversible rotary converter is being installed at the generating station.

The rotary sub-station is placed about one mile away from the generating station, and is fed through a 0·1-inch, three-core, steel-tape armoured, lead-covered and paper-insulated cable, capable of transmitting, in addition to the power at present required, a further 1,500 H.P. to meet future requirements. The present installation at the sub-station consists of a 500-KW. transformer and rotary. The H.T. switchgear consists of two truck cubicles, built up of cast-iron plates, housing the instruments and protective gear. The L.T. switchboard consists of five black-enamelled slate panels. A static sub-station is fed by a 0·05-in. feeder, and will provide the supply to the housing scheme and other consumers.

There are some 17 miles of cable laid in the town, the supply being laid on to all the 289 street lamps, and thus bringing electricity within the reach of practically every resident. From the works five feeder cables run to five different areas of the town, terminating in cast-iron feeder pillars from which the distributors run and branch off down the different streets. The whole of the cables are paper insulated, impregnated with insulating oil, lead covered and armoured with steel tape. The cables vary in copper section from 0·3 to 0·0125 sq. in., and are laid direct in the ground. The distributor cables are four-core, three of the cores being used for the general supply and the fourth core for the street lighting.

The street lighting is controlled in a novel manner from the works by means of remote-control switches placed at the end of the feeders, and operated by means of the feeder voltmeter pilot wires which run in the same core as the feeder cables. The immediate control of the street lighting from the electricity works effects a great saving in labour. A special street lighting wire is advisable, considerably reducing maintenance of the mains, and labour of lighting and extinguishing. Special all-night lamps or other lamps can efficiently be dealt with by means of time switches.

There are 426 consumers, who last year consumed 1,023,845 units of electricity. The excessive strain on the plant will be appreciated from the fact that a list of 16 comparable undertakings shows an average output of 790 units per KW. of plant, as compared with Aylesbury's 2,000 units per KW. of plant.

The capital cost of the undertaking is about £36,682, involving an interest and loan repayment charge of about £3,206 per annum. The financial result of the working of the undertaking for the year ending March 31st last is as follows:—

Income, £11,262; expenditure, £6,604; interest and loan redemption, £3,206; leaving a surplus of £1,450.

The lighting and power connections are equivalent to 923 KW., excluding a stand-by supply to two works, which about doubles the figure. The total plant capacity at the works, excluding the battery, is 1,400 KW.

In conclusion, thanks are due to Mr. W. A. Turnbull, A.M.Inst.C.E., A.M.I.E.E., borough electrical engineer and manager, who designed the above extensions and to whose specifications they were carried out, for his help in the preparation of this article and for supplying the photographs from which our illustrations were reproduced.

Liverpool Strike Settled.—The protracted dispute, involving the cable jointers and street box examiners, between the Electrical Trades Union and the Corporations of Liverpool, Wallasey, Birkenhead and Bootle, has been settled, and the men agreed to return to work last Monday. The Liverpool men had been on strike 13 weeks. The trouble arose through the men, whose rate of pay had been arranged by the Whitley Council, demanding a further increase, on the ground that men employed by private contracting firms were being paid a slightly higher rate. The Corporation declined to concede the advance, contending that the Joint Industrial Council was the proper authority to deal with the application. Thereupon a strike ensued. Last week, after a conference, the Liverpool Electrical Trades Union intimated that the men would return to work, having agreed to the matters in dispute being referred for arbitration to a committee of the Whitley Council, which sat in Manchester on Tuesday.

Electrical Trade in South Africa.—*The S.A. Mining and Engineering Journal*, of July 24th, says:—"Business in the electrical goods market is very slow, both in town and country, and prices remain about the same with a tendency to fall. Electrical materials are coming in pretty freely, and according to general reports, good stocks are on the way and shortly expected. No big contracts are going just now, and dealers are principally busy in sales of goods for repairs. However, on the whole, electrical goods dealers are not much perturbed over the present slackness, which they say occurs periodically, and are looking forward to a general improvement in the near future."

MESSRS. DEBENHAMS' ELECTRIC RESTAURANT.

An interesting installation of electrical cooking apparatus was recently completed, and is now in operation, in the restaurant at Messrs. Debenham & Freebody's well-known West End establishment, which both serves as an attraction and provides refreshment for the firm's customers in a manner that is beneficial to both parties.

Fig. 1.—Tricity Electric Cooking Range.

The electrical equipment, of which what follows is a description, was the joint work of two firms that need no introduction, namely, the British Electric Transformer Co., Ltd., and Carron Company, to whom we are indebted for our illustrations.

Dealing first with the "Tricity" apparatus, the cooking range illustrated in fig. 1 comprises three ovens having heating elements at their tops and bottoms. The inside measurements of these ovens are 24 in. cube; they are constructed of cast-iron with sheet-steel sides and backs, and are lagged with slag wool. The maximum loading of each oven is 5 kw., *i.e.*, 2 kw. at the top and 3 kw. at the bottom, the elements being controlled by two three-heat switches.

Three aluminium fish-fryers have also been installed; their inside dimensions are 18 in. by 10 in. by 6 in. deep. Each fryer is controlled by a three-heat switch, and is loaded to 2·5 kw.

Fig. 2 illustrates a combined carving table, hot cupboard, and Bain Marie. The length of the cupboard is 6 ft. 6 in. overall, its height being 2 ft. 5 in. The overall height, including the top shelf, is 3 ft. 5 in., the width of the shelf is 12 in., and the width of the cupboard and table 2 ft. The loadings of this piece of apparatus are:—Carving table top, including dishes, 1·5 kw., controlled by one three-point switch; hot cupboard (which has doors at both sides), 2·6 kw., controlled by one three-heat switch, and the hot shelf is controlled by a three-point switch; Bain Marie, 4 kw., and is controlled by one three-heat switch.

Two switches and two fuses are mounted on each Kartret panel and a pilot lamp is provided beside each switch.

Turning now to the "Carron" equipment, fig. 3 shows a standard electric boiling table, the dimensions of which are 8 ft. 9 in. long × 2 ft. 4 in. wide; this appliance is built up of six standard-type boiling fillings, each measuring 16 in. wide × 22 in. deep, which are fitted in a cast-iron frame with a polished moulding all round, ample provision being made in the frame for expansion and contraction of the fillings. Four of the fillings are fitted with two boiling sections, measuring 12 in. × 10 in. each, and loaded to approximately 2 kw., whilst the other two fillings in the centre, are fitted with four smaller boiling sections, each measuring 7 in. × 6 in., and loaded to approximately 1 kw. Provision is made that each individual filling can be raised to an up-right position in the frame, so as to afford easy access to the heating elements and connections when necessary.

A wrought-iron pan rack is provided, and the whole apparatus is supported on six strong cast-iron legs stayed with heavy angle iron, which ensures a rigid surface to the boiling table. The switchboard is mounted at a convenient height over the apparatus, and each circuit is separately controlled by a rotary indicating switch, fuse, and pilot lamp.

Fig. 4 illustrates an electric hot-cupboard and Bain Marie, the first-named piece of apparatus being constructed of cast-iron, with dimensions of 6 ft. 6 in. long × 2 ft. 9 in. high × 2 ft. 6 in. deep, and provided with a ground and polished top-plate and moulding all round. The sliding doors are of wrought-iron, with polished bands and handles, the back and ends of the appliance being also panelled. A shelf is fitted inside the hot cupboard, the heating elements, arranged under a covering plate, being loaded to a maximum of 3·5 kw., and arranged for three-heat regulation. The top-plate is independently heated with elements loaded to a maximum of 1·5 kw., also arranged for three-heat regulation as in the case of the hot cupboard, both sets of heating elements being independently controlled by switches fitted to a separate ironclad switchboard on which are also mounted the necessary fuses and pilot lamps for each circuit, together with the switches, fuses, and pilot lights for the Bain Marie.

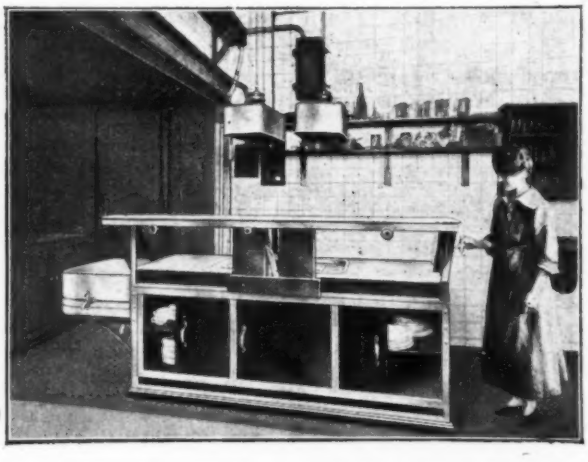


Fig. 2.—Tricity Combined Carving Table, Hot Cupboard, and Bain Marie.

The Bain Marie is constructed of heavy gauge copper, tinned inside with pure block tin and polished outside; its dimensions are 4 ft. long × 2 ft. 8 in. deep. The heating elements are clamped to the underside, loaded to a maximum of 15 kw., and arranged for three-heat regulation, which is sufficient to raise a 4-in. depth of water from 45° F. to

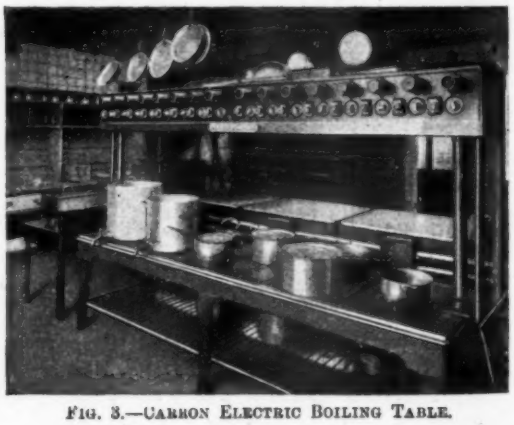


Fig. 3.—Carron Electric Boiling Table.

boiling point in approximately 35 minutes. A removable cover is also provided, which is shown in a raised or upright position in the illustration.

Fig. 5 shows a standard treble-compartment electric grill, constructed of cast-iron, the interior dimensions of each

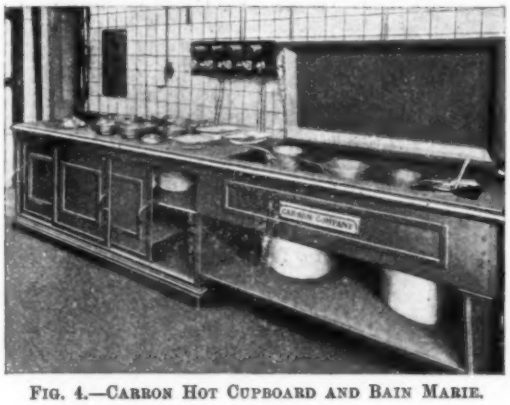


Fig. 4.—Carron Hot Cupboard and Bain Marie.

compartment being 24 in. wide × 18 in. deep, giving a total grilling area of approximately 9 sq. ft. The heating element in each compartment is loaded to a maximum of 6 kw., and arranged for three-heat regulation, the "low" heat having a consumption of approximately 1·5 kw.

Each section is provided with a polished wrought-iron brander, with cool-grip handles, and the four pairs of runners fitted to each compartment are so spaced that the top one brings the bars of the brander close up to the heating element, but allows sufficient clearance for toasting bread. The bottom of each grilling compartment is white porcelain enamelled, with an outlet in the centre, under which a removable gravy pan is fitted, as will be seen in the illustration.

The hot cupboard shown over the grilling compartments is the same width and depth as the grill, with a height of 18 in. A perforated centre shelf is provided, and the whole

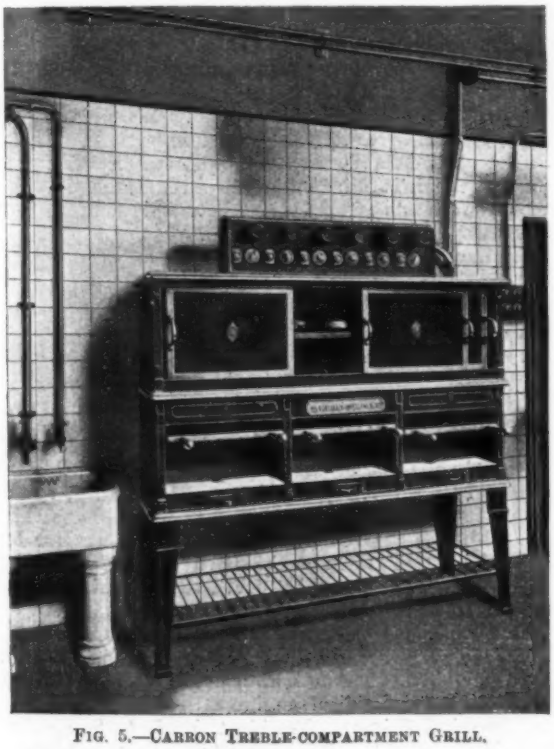


Fig. 5.—Carron Treble-compartment Grill.

apparatus is mounted on substantial cast-iron legs to bring it to a convenient working level. The hot-cupboard is heated by waste heat from the grill elements below it, and wrought-iron sliding doors are provided with polished centre panels. The switchboard is fitted on the top of the apparatus, and each circuit is arranged for separate control by a rotary indicating switch, fuse, and pilot light.

In addition to the above plant, there is also a three-tier "Jackson" steaming oven and two stock pots of cast aluminium; the latter simply stand upon ordinary "Tricity" hot plates. The stock pots, fish fryers, and all other cooking utensils are made of aluminium, on account of its light weight. It is found possible to make aluminium pans with a flat bottom more readily, and a noteworthy point is that once the pan has commenced to boil, the heat can be reduced, and the pan will continue to boil with the lid removed if necessary. With iron pans full heat is required to keep them boiling when uncovered.

As steam is available on the premises for other purposes, it is used to heat all water that is needed in the kitchen. The apparatus is giving entire satisfaction, and is capable of providing between 400 and 600 midday meals, the dining rooms having a seating capacity of about 400 persons.

With regard to cost of electricity the kitchen is, perhaps, fortunate in being situated in the Borough of St. Marylebone, but it may be said that, roughly, electric cooking is 25 per cent. cheaper than the old method of using coal and coke. In addition, there has to be taken into consideration the easy temperature control, cleanliness, and other well-known advantages of the electrical method, besides the elimination of the cost and labour of fuel handling.

Messrs. Debenhams, Ltd., to whom thanks are due for facilitating the preparation of this article, have shown commendable enterprise in the use of electricity for heating and cooking, as well as for lighting and power purposes, the installations in their various establishments being of considerable dimensions.

THE BRITISH STANDARD COOKING RANGE.

Specification No. 106 of the British Engineering Standards Association is of more than technical interest, for it marks an epoch in the development of domestic electrification, and shows that experience has now become sufficiently ripe to indicate primary requirements, and to permit cheaper methods of production without cramping initiative in respect of design or detail. We have for many years urged upon manufacturers the importance of adopting such measures of standardisation as may be found possible, particularly in connection with the replacement of heating elements, terminals, &c., and we cordially welcome this step in that direction.

Only those who have worked upon the Panels of the British Engineering Standards Association know the large amount of valuable and voluntary service which it has been able to enlist; the engineering world, however, appreciates the results, and looks upon its work with growing respect.

The specification for cookers deals with two standard sizes, for families of five and ten persons respectively, and offers little scope for criticism; moreover, it will, no doubt, come forward for revision as soon as progress warrants change in definition or requirements.

Generally the specifications issued by the B.E.S.A. suffer only from the fact that they define requirements, and cannot digress into comment or general observations. In the making of them most interesting discussions arise; points culled from experience in use and difficulties in production are carefully explored, and information is often revealed which cannot well be incorporated in a specification. Much of it might, however, prove valuable in the form of memoranda on the subjects dealt with, exhibiting as they would something of the scaffolding by means of which the specification had been erected.

In the general clauses, reference is made to the insulation of conductors leading to the elements, by means of beads; it seems probable, however, that the use of semi-flexible connections, and such doubtful protection as is afforded by beads, may become obsolete in well-designed ranges. The possibilities of rigid connections of the bus-bar type are promising, as well as the elimination of many

dry or bolted joints by means of electric welding, which has proved so adaptable to internal jointing in the winding of motors.

A number of valuable tests are set out, and conditions for their performance specified, but reference is not made to any definite ambient temperature, or to conditions concerning the size of, or ventilation in, the testing room, the air temperature of which might change considerably after a number of ranges had been tested.

Earthing is provided for, but the directions suffer from the weakness common to most earthing clauses; they prescribe the size of cable connectors to be used, in this case 0·007 sq. in., but cannot take into account the length of wire which may have to be employed to reach a suitable earth, or the possibility of indifferent connections. As the larger size of range may have a total capacity of 85 amperes at 100 volts, it will probably be fused on the main at not less than 120 amperes, and for such a low working pressure, the earth connection might with advantage be heavier to avoid risk of overheating.

The protection of live metal by guards is dealt with, but it is not easy so to guard radiant grill and boiler elements as to prevent their being touched with forks and at the same time to avoid screening their useful radiation; many elements have come to grief through attempts to make skewers red hot or to warm curling irons on them.

Clauses 9 and 10 deal with sectional switches and cut-outs, calling for D.P. cut-outs on each circuit except where one pole of the supply system is earthed, a condition which is so general that it would be worth while to emphasise the necessity for arranging all switches on the live or feed side of the supply.

Where the total loading exceeds 2½ KW., elements are to be divided into approximately equal circuits, each with its own pair of terminals. One must hope that these will not be used for the purpose of internal balancing across a three-wire system; such an arrangement may be tempting in lightly cabled areas, but will probably bring much trouble in its train. One house, one pair of wires, one meter, is surely an essential for general domestic supply.

The limit of range height (39 in.) seems substantially too much for the handling and inspection of heavy saucepans; it might prove more troublesome to a small cook than the usual low oven door is to a big one.

One of the important clauses (21) calls for oven elements to be self-contained and readily fixed or removed. So far, in this connection, "readily" has been a comparative term. A hand lamp, a few spanners, and one's head in the oven, will more or less readily achieve the removal of some oven elements; others can be changed with but little trouble. We have not yet found the "cartridge" element which will go in and out as easily as a lamp, and it is, perhaps, not worth while to increase cost very much to secure it, but standard centres, bolt holes, and terminals should help a great deal, and also, if possible, the ability to do all repairs without working inside the oven and without taking out the lagging.

There seems room for further improvement with regard to the temperature gradient at the ends of element wires; even where a good mechanical connection is provided between the hot wire and its connecting lead, the temperature change is abrupt, and if the heat could be dissipated gradually from the incandescent portion to the practically cold connection, some of the causes of failure would probably disappear.

The specification concludes with useful limits and instructions for testing the range and its components, so that uniform conditions may be secured.

From the figures given for energy consumed to raise the apparatus from cold to working temperature, and to keep it so, it is obvious that out of the four or five units per day needed to cook for the average family, something like half fails to reach the food, and is dissipated in what is, after all, from the point of view of heat conservation, the most efficient form of stove yet produced. This is a useful reflection which should prevent us from dwelling too much on the fact that the conversion of electricity into heat in an incandescent wire has an efficiency of almost 100 per cent.; there may yet be room for someone to evolve the "half-watt" cookery range by a radical change of method, such as an immersion heater in every pot, even if not eddy currents within the joints of meat.

THE BRITISH ASSOCIATION.—I.

Twenty-nine years have elapsed since Cardiff was last chosen as the meeting place of the British Association for the Advancement of Science, and much has been accomplished in the interval. In 1891, the late Sir William Huggins, F.R.S., acted as president, and his address dealt with spectroscopic astronomy. Papers dealing with electrical subjects occupied a more important place in that programme than in the present one, and among them may be mentioned those on "Electrolytic Problems," by Mr. Robert L. Mond; "Measurement of Liquid Resistances," by Mr. J. Swinburne; "The Lighting of Railway Trains Electrically," by Mr. Smith; and "The Telephoning of Great Cities," by Mr. A. R. Bennett, M.I.E.E., in which the author said: "A matter which has never yet been seriously faced is how the demand for telephonic exchange connection, which, after the lapse of a few more years, is bound to arise in all large cities, is to be met. As yet the merest fringe of telephony, as it will ultimately be when developed, has been touched. A time will come when every shopkeeper, and almost every householder, will require his telephonic exchange connection." The prophecy contained in the last sentence has been more than fulfilled, culminating in the modern problem of the provision of sufficient exchanges, lines and instruments to meet the demands of would-be subscribers. Another paper on telephony was contributed by the late Sir W. H. Preece, F.R.S., who described the working of the (then) new telephonic connection between London and Paris. Bearing in mind the fact that conversation on this line cost eight shillings for three minutes, the projected increases in telephone rates may perhaps be borne with fortitude.

Cardiff City itself has undergone changes since those days, but has never looked back. The population, numbering about 132,000 in 1891, has steadily increased until to-day it is estimated at well over 204,000. Until the outbreak of war the coal exports had gradually been increasing, and in the last pre-war year, 1913, reached a maximum.

This year's President is Prof. W. A. Herdman, who has for some time past held the office of joint hon. secretary. Prof. Herdman has carried out a great deal of important work for the Government in oceanographic research, &c. One of his missions was an investigation of Eastern pearl-oyster fisheries, which involved a journey to Ceylon. Among his more recent accomplishments was the establishment of a marine biological station in the Isle of Man. Prof. Herdman holds the Chair of Oceanography at Liverpool University, and is honorary director of scientific work to the Lancashire Sea Fisheries Committee. The Vice-Presidents for the Cardiff meeting include the Lord Mayor of Cardiff (Councillor G. F. Forsdike, J.P.), the Marquis of Bute, the Earl of Plymouth, P.C. (Lord Lieutenant of Glamorgan), Major-Gen. Lord Treowen, C.B., Lord Aberdare, D.L., Lord Pontypridd, D.L., and Lord Tredegar, D.L. The following are the sections chiefly interesting to electrical engineers:—A.—Mathematical and Physical Science. President, Prof. A. S. Eddington, M.Sc., F.R.S. B.—Chemistry. President, C. T. Heycock, M.A., F.R.S. F.—Economics. President, J. H. Clapham, C.B.E., Litt. D. G.—Engineering. President, Prof. C. F. Jenkin, C.B.E., M.A. L.—Education. President, Sir Robert Blair, M.A.

The usual procedure was departed from, the proceed-

ings commencing, early on the morning of Tuesday, August 24th, with meetings of the organising and sectional committees. The Presidential Address was delivered at the Park Hall at 8 p.m. the same day. The buildings placed at the disposal of the Association for the purpose of the meeting were the City Hall, Park Hall, University College, the Technical College and the South Wales Institute of Engineers.

The Presidential Address related to "Oceanography and the Sea Fisheries." Prof. Herdman, in his opening remarks, paid tribute to the memory of those in the world of science who fell in the war, making particular mention of Mosely, Jenkinson, Geoffrey Smith, Keith Lucas, Gregory and Leonard Doncaster. Proceeding, Prof. Herdman said that many great advances had been made in the science of the sea during the past quarter of a century. At the previous Cardiff meeting there were at least three papers of oceanographic interest contributed by Prof. Osborne Reynolds on the action of waves and currents, by Dr. H. R. Mill on seasonal variation in the temperature of locks and estuaries, and by Dr. Evans Hoyle, on a deep-sea tow-net capable of being opened and closed under water by electricity. The speaker noted that he was the first oceanographer to be chosen as President of the Association—but oceanography was the youngest of the sciences, depending chiefly upon the methods and results of other sciences—physics, chemistry and biology. Oceanography was world-wide in its scope, but also extended beyond our globe, and included astronomical data in their relation to oceanographical phenomena. In a brief review, the President traced the history of oceanography as a science from 1873 to the present time, mentioning the names of Sir John Murray, Mr. J. Y. Buchanan, and others prominent in this field. The extent of present-day knowledge of the science of oceanography was then outlined, in the course of which Prof. Herdman said that a great deal was known about the organisms floating or swimming in the surface waters (the epi-plankton) and also those brought up by dredges and trawls from the bottom in many parts of the world. Much still remained unknown, or only imperfectly known, even in matters that had long been studied and where practical applications of value were obtained—such as the investigation and prediction of tidal phenomena. Another point of practical value was the investigation into the ultimate causes of variations in the abundance, sizes, movements and qualities of the fishes of our coastal industries. He gave many examples of estimates and calculations made by oceanographers in this direction, and in conclusion emphasised the importance of oceanography to the whole population of these islands—a maritime people which owed everything to the sea.

Engineering Section.

Presidential Address by Prof. C. F. Jenkin, C.B.E., M.A.
(*Abstract.*)

As the result of his work on problems connected with materials of construction for the Air Service, the author has come to the conclusion that the time has come when the fundamental data on which the engineering theories of the strength and suitability of materials are based require thorough overhauling and revision.

Again and again in aeroplane engineering the problems to be solved have raised fundamental questions in the strength and properties of materials which had never been adequately solved. The strength of timber is enormously greater along the grain than across it. How, then, is an engineer to calculate the strength of a wooden member? There is no theory, in a form available for the engineer, by which the strength of members made of an anisotropic material can be calculated. It is obviously important to get the grain in exactly the right direction to bear the loads it has to carry.

Many of the tests applied to timber are wrong in theory and consequently misleading. For example, the common method of determining Young's modulus for timber is to measure the elastic deflection of a beam loaded in the middle and to calculate the modulus by the ordinary theory, neglecting the deflection due to shear, which is legitimate in isotropic materials; but in timber the shear modulus is very small—for example, in spruce it is only about one-sixtieth of Young's modulus—and consequently the shear deflection becomes quite appreciable, and the results obtained on test pieces of the common proportions lead to errors in the calculated Young's modulus of about 10 per cent.

Steel is not strictly isotropic—but we may consider it to be so to-day. The first obvious question the engineer has to answer is: "What is its strength?" The usual tests give the Ultimate Strength, Yield Point, Elastic Limit, the Elongation, the Reduction of Area, and perhaps the Brinell and Izod figures. On which of these figures is the dimension of an engine part, which is being designed, to be based? If we choose the Ultimate Strength we must divide it by a large factor of safety—a factor of ignorance. If we choose the Yield Point we must remember that none of the higher-grade steels have any Yield Point, and the nominal Yield Point depends on the fancy of the tester. This entirely imaginary point cannot be used for accurate calculation except in a very few special cases. Can we base our calculation on the Elongation——the Reduction of Area—the Izod test? If we face the question honestly we realise that there is no known connection between the test results and the stress we can safely call on the steel to bear. The only connecting link is that cloak for our ignorance—the factor of safety.

I feel confident that the only reliable property on which to base the strength of any engine part is the suitable *Fatigue Limit*. We have not yet reached the position of being able to specify this figure, but a considerable number of tests show that in a wide range of steels the Fatigue Limit for equal + and − stresses is a little under half the Ultimate Strength, and is independent of the Elastic Limit and nominal Yield Point, so that the Ultimate Strength may be replaced as the most reliable guide to true strength, with a factor—no longer of ignorance, but to give the fatigue limit—of a little over 2.

If the Fatigue Limit is accepted as the only sound basis for strength calculation for engine parts, and it is difficult to find any valid objection to it, then it is obvious that there is urgent need for extensive researches in fatigue, for the available data are most meagre.

Improved methods of testing are also needed—particularly methods which will give the results quickly. Stromeyer's method of measuring the first rise of temperature, which indicates that the fatigue limit is passed, as the alternating load is gradually increased, is most promising. It can probably be simplified in detail and made practicable for commercial use. Better methods of testing in torsion are also urgently needed, none of those at present used being free from serious defects. Finally, there is a fascinating field for physical research in investigating the internal mechanism of fatigue failure. Some most suggestive results have already been obtained, which extend the results obtained by Ewing.

For members of structures which are only subjected to steady loads I suggest that the safe stress might be defined by limiting the corresponding permanent set to a small amount—perhaps ½ per cent. or ¼ per cent. This principle has been tentatively adopted in some of the aircraft material specifications. Whether this principle is suitable for all materials and how it will answer in practice remains to be proved by experience. It is at any rate a possible rational basis for determining the useful strength of a material under steady loads.

If we admit that the fatigue limit is the proper basis for engine-strength calculations, there are a number of interesting modifications required in the common theory of the strength of materials. It will no longer be possible to neglect, as has been so general in the past, the uneven distribution of stress in irregularly shaped parts of machines. It has been generally recognised that sharp corners should be avoided when possible, but no theory is available to enable the stresses at corners to be calculated or to enable their effect on the strength of the member to be estimated. If fatigue is the critical factor in failure under fluctuating stresses, such theory is most necessary. Even the roughest guide would be of great value. The nature and magnitude of the concentrations of stress which occur in practice have been investigated experimentally by Prof. Coker by his elegant optical method, which has given most valuable results, some of which are already being used in designing offices. If the mathematical theory is too difficult, it may be possible to lay down practical rules deduced from such experimental results—but the method still has many limitations, perhaps the most serious being that it can only be used on flat models. I believe Prof. Coker expects to be able to extend the method to round models.

As a simple example to show the importance of the subject let us consider the effect of a groove round a straight round bar subject to alternating tension and compression—such a groove as a screw thread. There will be a concentration of stress at the bottom of the groove. The ratio of the stress at the bottom of a groove to the mean stress in the bar has been worked out mathematically by Mr. A. A. Griffith, and his calculations have been confirmed experimentally by his elegant soap-bubble method. The ratio depends on the relation between the depth of the groove, the radius at the bottom, and slightly on the angle between the sides. For a Whitworth form of thread the ratio will be about 3. If the Fatigue Limit is exceeded at the bottom of the groove the metal will fail and a minute crack will form there; this crack will soon spread right across the bar and total failure will result. Thus we see that the safe mean stress in the bar will be reduced to one-third of what a plain bar will bear. The truth of this theory regarding the importance of concentrations of stress has still to be proved experimentally; if true, it is of far-reaching im-

portance, since it applies to all concentrations of stress in machine parts subject to fluctuating loads.

The theory does not apply to steadily loaded members; in these the local excess of stress is relieved by the stretching of the minute portion which is overloaded, and no further consequences follow.

The theory appears to apply to grooves however small, and has an important bearing on the smoothness of the finish of machine parts. The surface of any engine part finished by filing is certainly entirely covered with scratches. Emery likewise leaves the surface scratched—though the scratches are smaller. If, however, polishing be carried further the surface may ultimately be freed from scratches and left in a burnished condition. In this condition amorphous metal has been smeared over the surface—the smooth appearance is not simply due to the scratches being too small to see. The strength—under alternating stresses—appears to depend on the form of the scratches, and if the ratio of radius at the bottom of the scratch to its depth is fairly large, very little weakening occurs. It seems probable in the ordinary engineering finish produced by emery and oil that the scratches are broad and shallow. This subject is being investigated. A considerable amount of evidence has been collected from practical experience pointing to the important effect which a smooth finish has on the strength of heavily stressed engine parts.

There are more fundamental questions still which must be tackled before the simplest questions of all which meet the engineer can be answered scientifically. The two most urgent and most important questions which I met with during the war in connection with aircraft were always the same—Why did some part break? and, What is the best material to use for that part? It was most disconcerting to find how inadequate one's knowledge was to answer these two simple questions.

Until the nature of the load which caused the failure is known, it is very difficult to take steps to guard against similar accidents. For the most urgent reasons, therefore, we require to be able to understand the fracture, as in nearly all aircraft problems men's lives hang on the answer.

Perhaps the quality of steel which an engineer fears most is brittleness. He believes that annealing will soften it and reduce the brittleness; so he anneals, blindly. The fact is that we do not know what brittleness is—we cannot define it—we cannot measure it—though there are endless empirical tests to detect it. Till we know what it means and can measure it we are in a miserable position.

The suitability of different materials presumably depends on their fundamental physical properties. These may be many, but some physicists think that they are probably really very few, and that, knowing these few, it may be possible to deduce all the complex properties required by the engineer and to state with certainty how materials will behave under any conditions of service. This is the most fundamental problem which needs solution to enable the knowledge of the strength of materials to be put on a sound foundation. It will need the co-operation of able physicists, metallurgists, and engineers to solve it.

Mathematical and Physical Science Section.

Presidential Address by Prof. A. S. Eddington, F.R.S.
(*Abstract.*)

The author in his address dealt with "The Internal Constitution of the Stars," and explained some of the remarkable discoveries which have been made in recent years in connection with this subject. In the "giant" stars, which consist of a diffuse mass of gas, heat is present in two forms—the energy of motion of material atoms, and the energy of ether waves; in hot bodies familiar to us the latter form is of insignificant proportion, but in the giant stars the two forms are of approximately equal importance. The outflowing stream of ethereal energy distends the star and relieves the pressure on the inner parts; and the transparency of stellar material to the radiation traversing it links the subject of inquiry to physical investigations now being carried on in the laboratory. In the stars we are dealing mainly with ether waves of very short wave-length, which might be described as very soft X-rays. It can be shown that the mass-coefficient of absorption in the star must be between 10 and 130 C.G.S. units, the most likely value being about 35, which is of the same order of magnitude as the absorption of X-rays found in the laboratory; more than half the radiation is absorbed in a path of 20 cm. at atmospheric pressure, and this explains why a star is so nearly heat-tight, and can store vast supplies of heat with comparatively little leakage. At the high temperatures of the giant stars the opacity is the same for all, showing that the absorption of which an atom is capable has a limiting value, which is never approached in the laboratory. The total radiation of a giant star depends only on its mass, and as these stars all have nearly the same luminosity, it follows that the masses are remarkably alike—mostly within limits of 3:1.

The source of heat of the sun and stars is usually said to be the gravitational energy converted as the star steadily contracts, but this theory is untenable; the stars are drawing upon some vast reservoir of energy, which can scarcely be other than the sub-atomic energy which exists abundantly in all matter, and is well-nigh inexhaustible—if it could only be tapped. It appears certain that all the elements are constituted of hydrogen atoms bound together with negative electrons, and if only 5 per cent. of a star's mass consists initially of hydrogen atoms, which are gradually being combined to form more complex elements, the total heat liberated will more than suffice to account for the star's energy.

INDUSTRIAL PSYCHOLOGY.

By E. S. HODGSON.

Practically all industrials are agreed that a proper system of scientific shop management and payment by results offers the ideal solution to the labour problem. Objections come, however, principally from the trade-union side. The workers object, quite rightly, that any system of payment by results which is based on the achievements of the most skilled is unfair, as it makes no adequate allowance for the many workers who, through lack of proper training, have been unable to attain the necessary degree of skill. German industrials seem to be recognising this objection, and many of the larger firms are being attracted seriously to the question of applying psychological and fatigue tests to determine a man's suitability for certain work, evidently inspired by the maxim that the right man should be in the right place.

During the war a laboratory for psychotechnical investigations was established at the Berlin Technical College to deal in a systematic manner with the selection and training of apprentices and workpeople. Various instruments have been designed and tests prescribed, which a number of the larger concerns in Berlin are already using. For the apprentices, a number of simple tests in attention, sight, touch, feel, have been drawn up, and these are applied gradually in the works, sometimes by means of suitably designed instruments. The apprentices and others are then sent to the laboratory, where the tests carried out in the shop are repeated and the results compared. In this way the director of the laboratory is able to give the works management valuable advice as to the ultimate suitability of the apprentices for the work for which they are destined.

As these tests reach a more advanced stage, they are combined with motion studies and time records, as a result of which careful charts are drawn up, and a suitable average is struck.

Dr. Schlesinger, one of the directors of the laboratory, recently delivered a lecture on the subject before the German Society of Engineers, showing the useful information that had been gained as the result of a comprehensive series of tests made at various establishments. At one works, careful records were kept of the progress of a group of apprentices, and their efficiency in various subjects (shop practice, mathematics, and professional knowledge, designing, and gymnastics) noted. By taking a group of subjects in this way, and comparing the results in each group, the skilled observer can readily determine in just what branch of engineering or shop practice the apprentice will make good. One of the large Berlin electrical firms adopted the same idea with regard to female winders, being able, as the result, to reject those whose ultimate progress would not justify their employment. In the same way the telephone operators in one of the telephone exchanges were tested at the laboratory for psychotechnics, by means of a specially designed instrument calling into play all the faculties in which a high degree of development is necessary in their calling, the results being plotted in efficiency curves.

The idea is gaining ground in Germany, and many of the workpeople themselves seem to be interested in the results, because they realise that they are not likely to be put on jobs for which their physical and mental efficiency fits them ill. Institutions have also been established for testing the suitability and efficiency of engine drivers and road vehicle drivers, and for dealing with the psychology of advertising, to which latter subject the Americans undoubtedly owe a great deal of their success in publicity.

ELECTRICITY SUPPLY IN THE UNITED KINGDOM.

ELECTRICITY COMMISSION'S WORK IN THE PAST YEAR.

THE report of the Ministry of Transport respecting applications to, and proceedings of, the Ministry under the Electricity (Supply) Acts, 1882 to 1919, during the past year has just been issued by H.M. Stationery Office [132. Price 2d. net], and is dated June 26th, 1920. It deals with the work done since the last report was issued by the Board of Trade on June 25th, 1919, and since the transfer of the powers and duties of the Board to the Ministry on January 23rd last.

In the early part of the period under review the Board of Trade received four applications for Provisional Orders; the documents lodged in connection therewith were in due course transferred to the Electricity Commissioners.

Between the date of the Board of Trade's last report and the date on which its powers were transferred to the Ministry, the Board gave consent to the construction of a generating station by the Portrush Urban District Council and by the Stroud Electric Supply Co., Ltd. Orders were also issued permitting 18 undertakings to supply electricity to certain specified premises outside their prescribed area of supply, extension of time for the performance of duties or the exercise of powers under 12 Acts and Orders was granted, 73 undertakings were permitted to modify their charges for electricity, consent was given to the placing of electric lines above ground to 22 concerns, and a deed was made transferring the powers, duties, and liabilities of the undertaker under the Warminster Electric Lighting Order, 1914, to the Warminster Electric Supply Co., Ltd. In addition, the Board served notices and regulations [dealing with restrictions to the placing of electric lines, &c.] on the owners of lines and works constructed without statutory authority in seven districts.

It is common knowledge that, since their appointment, the Electricity Commissioners have made a preliminary survey of the present and prospective electrical requirements of the greater part of the country, and have held numerous conferences in this connection. They have provisionally determined six electricity districts* [the London area has since been determined], and the preliminary survey has embraced other districts of great importance from the point of view of electricity supply.

The Commissioners considered the four above-mentioned applications made to the Board of Trade for Provisional Orders; the three applications from the South Wales Electrical Power Distribution Co. are still under consideration, but that from the Havant Urban District Council was refused.

The Commissioners have given consent to the construction of a temporary generating station by the Belfast Corporation pending the completion of the station authorised in January, 1918. Certain applications for consent to establish new generating stations and a considerable number of applications for permission to extend existing stations have been dealt with, and in the majority of cases a good case was made for the works or plant in question. With regard to the establishment of new stations, special reference is made to the applications of the Manchester and Leicester Corporations, which have been granted, to establish at Barton, and Aylestone Road, Leicester, respectively stations with initial capacities of 50,000 and 10,000 KW., with the possibility of ultimate extension to 150,000 and 50,000 KW. Concerning the applications of the Nottingham Corporation and the Derbyshire and Nottinghamshire Electric Power Co., the Commissioners are satisfied that two large stations are necessary in the neighbourhood, and they have held a local inquiry.† Three other applications for consent to establish new stations are still under consideration; in one case the proposed initial capacity is 66,000 KW., with the possibility of ultimate extension to 200,000 KW.; in another case an initial capacity of 45,000 KW. is proposed; and in the third case the capacity is as yet undecided.

In certain cases of the few proposals that have been submitted for the establishment of new private generating stations regulations governing the type of current, frequency, and pressure to be used have been prescribed by the Commissioners, who have also approved of arrangements for mutual assistance being entered into between Bristol Corporation and the Keynsham Electric Light and Power Co., Ltd., and between the Corporations of Nelson and Colne.

A scale of maximum periods to be allowed for the repayment of loans raised by local authorities has been fixed, and during the six months ended June 26th last, 227 applications to borrow money have received consideration. Formal sanction has been issued in the case of 55 applications in England and Wales involving a total sum of £1,863,405, and in three cases in Scotland involving £263,830; no application was received from Ireland.

The Commissioners have, on application, consented to certain authorised undertakers subscribing to the funds of the Incorporated Municipal Electrical Association, the British Engineering Standards Association, and the Electrical Development Association; they have also prepared draft rules of procedure with respect to applications for special orders under the Act.

The Commissioners have, during their period of office, permitted 23 undertakers to supply electricity to certain specified premises outside their prescribed area of supply. The Minister of Transport has allowed 19 concerns to modify their charges for electricity; has extended the time for the performance of duties or the exercise of powers in the case of five Acts or Orders; and has consented to 17 undertakers placing electric lines above ground. The Minister, in March last, made an order for the cesser of the powers of the Gloucestershire Electric Power Co. as to the whole of the area of supply under that Act. In addition, he has at present under consideration two important applications for the construction of interim works.

* ELECTRICAL REVIEW, May 21st, p. 646; June 11th, p. 764; June 25th, p. 815; July 23rd, p. 106.

† ELECTRICAL REVIEW, July 30th, 1920; p. 155.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity Supply Restrictions.

I shall be interested to know to what extent different electric supply concerns are justified in imposing very difficult conditions with regard to the electric motors installed on their mains. It seems to me that the requirements imposed by the Ealing Municipal Undertaking are frivolous and vexatious, and are a severe handicap on any manufacturer who has the misfortune to be in the district.

The large number of different kinds of electricity supply in Great Britain make it difficult enough for electric motor manufacturers and users. Surely the added inconvenience of useless conditions, which are expensive to attain and which achieve no result, is an unnecessary obstruction.

I shall be pleased to hear the views of other engineers on this question.

J. M. Seddon.

London, S.W.1.
August 19th, 1920.

Tests for Electric Welds.

I have read with great interest your review on "Practical Electric Welding" by Mr. H. B. Swift. There is one paragraph towards the end on which I should like to make some remarks. It runs:—

"Perhaps the most remarkable omission is that hardly any mention is made of tests to be applied to determine the quality of welds. The author's silence is perhaps best explained by the fact that there is no specific test for welds. But some reference might have been made to microscopic and radiographic methods, which have a certain measure of utility and have been developed to some extent."

I have been interested for some time in the practical examination of materials by X-rays, and I used to think that welds formed one of the most hopeful fields; for certainly at the present time there is no method apart from X-rays by which a weld can be tested without destruction. In practice this applies to the microscopic method, as this means cleaning and etching.

X-ray photography of any weld up to 1 in. in thickness is a quick, easy, and certain job (greater thicknesses can be done, of course, but the difficulty increases rapidly). The amount of detail shown is extraordinary, and even those welds passed by inspection as practically perfect are shown under X-rays to be full of defects.

From 12 in. to 24 in. length can be taken at one time, the whole process occupying a fraction of a minute. If, therefore, there is any object in the laborious photomicrography of a small piece of a weld, surely there is far greater use in the easier photography of a greater length, and the argument that it would take too much time to do the whole of a long length of weld falls to the ground. It would take years to do it by photomicrography.

I enclose you an illustration of a particularly interesting weld, supposed by the expert who made it to be perfectly good. When cleaned off, it was difficult with the naked eye to distinguish between the welded portion and the untouched portion of the plates. There were no blow-holes or flaws visible on the surface, yet radiography shows a large number of flaws. The actual presence of one or two of these I tested by cutting the metal, the two dark spots being datum points formed by lead pellets.

Few welding people appear to be in the slightest degree interested in this new departure; indeed, their remarks lead one to believe that they are too much afraid of what the X-rays might show in their so-called perfect welds.

Lloyds do not consider the method useful because it has never been tried, and they have no data to check it against. I wonder where Lloyds would have been if ships had never been tried.

H. E. Donnithorne.

London, N.W., *August 23rd*, 1920.

POWER FACTOR.

By C. TURNBULL.

In the Electrical Review of June 4th there appeared an article by me entitled "Power Factor from the Business Man's Point of View," and in the June 25th issue there followed a criticism by a correspondent which is welcome for two reasons: it keeps the subject alive, and it is frank. Frankness is a fine thing in technics, for it elucidates dark places, and tends to correct errors. A regular course of frank discussion between students and professors at our colleges would do more to brighten up educational methods than the appointment of five hundred highly paid inspectors, particularly if old students were brought into the mêlée, after they had had enough outside experience to enable them to know what's what, and also had gained sufficient confidence to state their opinions plainly.

Possibly to "Correspondent" the article seemed to be written for the purpose of educating business men in the technical matters relating to alternating supply, but this was not quite its purport. The real object of the article was to put into the hands of the sales department a weapon by which the man, who is negotiating the price for energy, can persuade the consumer to do something to improve his power factor, or else to pay extra for energy used at low P.F.

The consumer is not generally anxious to understand the problem, for as soon as he does understand it, he must admit that it is just that he should pay a higher rate where his power factor is low. But why should he pay extra for such current? The answer is that electricity supply is a kind of co-operative concern, and the total expenses of the undertaking are spread over all consumers, and hence everyone is concerned when any one consumer uses current at low power factor.

"Correspondent" points out, justly enough, that wattless current has a useful function in that it supplies magnetising current to induction motors. But this argument does not make it clear that the magnetising current should be supplied free. On the contrary, the fact that wattless current does useful work is a good reason why it should be paid for. Consumers who have synchronous motors which operate at unity P.F., or which even run with leading P.F. (and so bear the burden of other people's sins), should get off with a lower price. It may happen that the running of a large synchronous motor at leading P.F. may do so much to reduce the load on the system, that it would pay the supply authority to supply energy free to the consumer who had it. Yet at present nothing is done to encourage people to put in such useful motors. If magnetising, or wattless current were charged for on a sound basis, it is probable that some large users would install a motor generator to give a supply of direct current by which they would run many of their motors synchronously.

Now comes the problem: Why cannot we charge the consumer extra for his bad P.F.? People buy all kinds of things, the composition of which they don't understand, and still less do they understand how the price is made up. A man buys sausage, for instance, without the remotest notion of how it was made, or what went into it. Why should he not pay for electricity just what the supply authority likes to charge, when the power factor could be allowed for in making up the bill? The answer to this is that supply authorities, unlike sausage makers, are not free to charge as they like. They must sell kilowatt-hours, and the problem of charging for a current which oscillates between a motor and the system does not seem to have been solved. Suitable meters are either not in existence, or if they are, they have not come into common use. The problem will be solved some day, and then "wattless" or oscillating current will pay its share of the generating costs of the system.

Here we may usefully discuss in detail just what lagging current really is, for lagging current is what troubles our mains systems. The text books are not very clear on the point, indeed British text books are not clear throughout, at any rate to learners (and that is just where a text book ought to be clear if it is to be of much use). Their authors seem far more anxious to cram pupils to pass examinations than to leave them with an entirely lucid and workable understanding of their subject.

The explanation is something like this: When alternating current passes through a circuit which has resistance only (resistance is much the same as friction) it behaves like direct current. The current at any instant is proportional to the pressure, and what is most important, it ceases as soon as the pressure becomes zero, and reverses when the pressure reverses. In a word, the current is in phase with the pressure. When, however, there is inductance in the circuit—and there generally is—the current ceases to act in this highly respectable manner. Instead, when the applied pressure becomes zero, the current over-shoots the mark, and continues for a short time in the same direction. Even when the voltage reverses, the current continues to move under what is virtually its momentum, even though it is running against the supply voltage. (Of course, current never goes against the voltage really impressed on it. What really happens is that the momentum generates a voltage of its own, and the current flows in accordance with the algebraic sum of the outside voltage and that generated by its own momentum.)

There is nothing very surprising in all this. When one is pedalling along a good road on a bicycle, motion does not stop when we cease pushing the pedals. If a cart suddenly appears right in front, the bicycle will continue to run along some distance in spite of the most vigorous application of the brakes, or against the back-pedalling efforts of the rider, if he happens to have a fixed wheel which will respond to back pedalling. The bicycle in fact runs along against the pressure, and does work on the rider. Now, when current runs with its pressure it absorbs energy, just as the bicycle does, but when current runs against its pressure, it does work instead of absorbing it. Thus when a generator is working with low power factor current, it is only giving out energy when the current is actually flowing in the same direction as the pressure. When the current overshoots at the end of each pressure wave, the generator becomes a motor, and absorbs energy from the mains system.

This gives us the reason why it is possible to have apparently 10,000 K.V.A. going out of a generator, with little steam on the engine. The power is there right enough, in spite of the airy use of the term "wattless current," a phrase which has (justifiably) puzzled so many, and is likely to puzzle a good many more before our text-books become a little clearer. What is happening, of course, is that current is driven out of the generator during part of the cycle, and during the rest of the cycle it surges back again and motors the generator. It is only necessary for the engine to make up the difference between the power which goes out and the power which comes back.

When this energy is metered the meter disk is impelled round one way for part of each cycle, and in the reverse direction for the rest of the cycle. If the disk had little or no momentum, it would oscillate to and fro, moving further in one direction than in the other, but having momentum it strikes a balance between the forces, and moves forward according to the difference between them.

One may illustrate the matter by an analogy. Let us imagine a single-acting air-compressor driven by a D.C. motor, without any fly-wheel, and let us suppose that the air compressor cylinder is connected to a 500-lb. pressure receiver, without any valve in the connecting pipe. The motor drives the piston against a steady resistance until it returns, and then the compressor drives the motor. We, therefore, get on the D.C. mains an oscillating current, first from the mains into the motor, and then, when the motor is being driven as a dynamo, back to the mains.

If we try to integrate the power by means of an indicator on the cylinder, we will find that there is practically no consumption of energy, and if we have agreed to accept pay on this basis, we shall find we have made a very bad bargain. This is practically what we do when we meter low-power-factor current on an ordinary integrating meter, taking no note of the loss that occurs in dealing with the power which oscillates through the mains system from the generator to the motor and back again.

If consumers were in the habit of putting loads like this on D.C. mains, it would not be long before a method would be devised for making them pay up. In the case of alternating current, the oscillations take place so rapidly, a complete cycle taking about the fiftieth of a second in most cases, that the whole thing is masked. Some rolling-mill motors take their power in a series of rushes, with a 0.3 power factor, and at that they are probably paying the same rate as they would if the P.F. were unity!

A large consumer may take 1,000 K.V.A. of "wattless" current without paying for it. Although classed as "wattless," the current requires as much generator capacity, as much switchgear, and mains as if it had been "wattful" current, while coal consumption is also increased on account of mains and other losses. In his criticism of my first article, "Correspondent" was severe on my omission to note that the engine and boiler capacity is not increased by wattless current. It may seem a strange omission to one outside the commercial side of generation on a large scale, but if "Correspondent" will have a heart-to-heart talk with one who is familiar with an undertaking supplying thousands of square miles, he will find that the statement was not so far wrong. The other day I had the pleasure of seeing some switchgear for a large station. The cost of it was said to be £5,000. It was rated in amperes, and carried precisely the same number of them as wattless current, as at unity power factor.

Definition of Power Factor.—We have seen from the above that when current is supplied to apparatus which causes the current to lag behind the supply voltage, it is not all effective. Part of the current works the machine, and the remainder oscillates to and fro between the machine and the mains. The effect when currents lead is similar, but currents do not often lead on present-day systems. The apparent power got by multiplying the volts by the amperes is, therefore, not the effective power.

Precisely the same thing happens in an oil engine. The burning charge gives the piston an impulse which is transmitted to the crank on the outstroke, but on the return stroke much of the power is taken back to compress the gases in the cylinder. We might use the words power factor equally well to denote the ratio of the work done in the cylinder, if there was no compression, to the work done when compression is deducted.

It would be awkward if we had to get at the power factor by taking oscillograph diagrams in each case, working out the effective power, as we do in the case of an oil engine. Fortunately for us, our instrument-makers have provided us with instruments which give us by inspection the power factor in the form of a multiplier which we can apply to the ammeter reading. If the P.F. indicator shows a reading of 0.5, it means that only half the power put into the motor is effective, the remainder being wasted (commercially speaking) in oscillations which bring in no money to the suppliers. In such a case, if the copper in the supply mains costs £200, it means that £100 worth of copper is taken up with unremunerative currents.

In conclusion, let me once more press the bank analogy. A man pays his cheque into the bank, and straightway issues cheques for income tax, rates, and (if there is anything left) for other bills. Within a few hours the money has evaporated. It has not increased the balance at the bank, and the effect has been "wattless." Does the banker let the transaction go free? Not at all. He charges for it as turnover. Before long we will be charging for "wattless current" too.

A very interesting note on the loss which occurs through low-power-factor current is given in Glover's Almanac for August 20th. The following extract from the note will explain itself. The full statement may be seen by the fortunate possessors of that most useful calendar:—

> The total I R losses of the generating and transmission system outlined below have been reduced from 5,610 KW. to 2,670 KW. by the installation of a 7,880 K.V.A. synchronous condenser.
>
> An alternative is to supply the motor magnetising current from a synchronous condenser near the motor load. A 7,880-K.V.A. synchronous condenser installed as suggested increased the power factor to unity at the generating station, reduced the I R losses of the system by 2,940 KW., and minimised problems of voltage regulation.

This should convince the most sceptical of critics that "wattless" current is neither wasteless nor costless.

Conclusion.—The conclusion of the whole matter is that up to the present time, the power-factor problem has not received the commercial attention that it merits. This is partly due to the unfortunate word "wattless," which has masked the expensive nature of oscillating currents. It would help to focus attention on the problem if we were to make use of a term denoting inverse power factor. This might be named current factor. Instead of speaking of a P.F. of 50 per cent., we would speak of a current factor of 200 per cent., which would indicate that the motor was taking twice the current that was necessary at unity P.F.

The time has come for commercial engineers to encourage inventors to bring out instruments which will measure the wattless component of lagging currents. Too often, when an invention comes out, commercial men think it a good thing to get the patent quashed in the courts on one of the frivolous pretexts which judges think good enough to damn patent cases with. The policy is a ruinous one, for it prevents many much-needed ideas from seeing the light of day. It would be worth while trying to give our commercial men some idea of technics, if it could bring them to look on inventors with the same honesty that they show in other transactions.

LEGAL.

Street Obstruction.

At Darwen, on August 19th, Messrs. Callender's Cable and Construction Co., Ltd., Blackburn, was summoned for obstruction. It was explained that in the course of excavation the workmen struck an electric lighting cable and sent for the Corporation men to do the jointing. The latter asked them not to fill in the excavation until they had finished. Fined 10s.

Crane Driver's Fatal Fall.

A case was heard on August 18th, before Judge T. Mordaunt Snagge at the Rugby County Court, in which Edith May Chamberlain, of Hillmorton, sued the British Thomson-Houston Co., Ltd., for £300 compensation alleged to be due to her in consequence of her husband's death in the course of his work. In June last he fell from a crane and died three days later. It was urged for the company that, as the man fell in stepping from one crane to another by means of a girder instead of using the ladders provided for the purpose, the claim could not succeed. For Mrs. Chamberlain it was pointed out that there was absence of definite instructions by the company, and evidence was given to show that the practice was commonly indulged in by crane drivers. Judgment was given in Mrs. Chamberlain's favour for the full amount claimed.

BUSINESS NOTES.

Bankruptcy Proceedings.—Arthur Kershaw, 7, Chesnut Terrace, Thornhill Lees, Dewsbury, and Charles Herbert Wood, 31, Warwick Road, Batley, trading in partnership as electrical engineers and merchants at 9, Bradford Road, Dewsbury.—A meeting of creditors was held on Friday last, at the Dewsbury County Court. The statement of affairs showed liabilities expected to rank for dividend amounting to £4,484. The assets were set down at £2,828, leaving a deficiency of £1,858. The causes of failure are alleged to be "losses on contracts due to fluctuations in market prices and workmen's wages, shortness of capital, law costs, and heavy initial business expenses." The deficiency account shows, amongst other items, net loss arising from carrying on business from April 1st, 1919, £471; depreciation of stock, tools, trade fixtures, fittings, &c., £717; drawings from business for household and personal expenses since April, 1919—Kershaw, £186; Wood, £185; and damages for breach of contract, £100. The Official Receiver states that Kershaw and Wood are each 22 years of age, and unmarried. They both joined the Army in 1914, and were demobilised in March, 1919. Kershaw commenced the business on April 1st, 1919, with £108 capital, and borrowed £200 subsequently from a friend. Wood became a partner in the business on May 27th, 1919, and introduced £90 capital—£50 of which he borrowed from a friend. That amount was still owing. Further sums were borrowed by debtors, amounting to £290, from the friend who had previously lent Kershaw £200, and they gave him a promissory note for £490. On March 31st, 1920, a chartered accountant prepared for them a balance-sheet, which showed a deficiency of £862. The trading account gave the turnover for the year ending March 31st last £4,674, and the loss on trade during that period £833. Debtors stated that in June last, when the stock was again taken, they discovered an error in the March stocktaking, and that the stock in that balance-sheet should be increased by £300. They were first sued on December 31st, since which time they had been sued by 12 creditors. The unsecured creditors include 52 claims for cable, lamps, conduits, and electrical accessories, &c., £3,281, and money borrowed, £490. In the separate estates, Kershaw has an unsecured creditor for clothing, £10 10s., and one for money lent on joint and several promissory note, £320; and Wood has one unsecured creditor for money lent (June, 1919), for £50, and another for money lent on joint and several promissory note for £320. Neither debtor has any assets. On the proposition of the Deputy Official Receiver, who said special proxies had been sent in for the appointment of Mr. Charles Turner, chartered accountant, Sheffield, as trustee of the estate, amounting to £1,831 out of £2,925 proofs filed and admitted for voting, seconded by Mr. E. P. Lobley, Mr. Turner was appointed. The following Committee of Inspection was appointed:—Ediswan Electric Co., Ltd.; Hallamshire Electric Co., Ltd., merchants, Sheffield; and Mr. Harry Haley, Batley, merchant.

Walter Dennell (trading as W. Dennell & Co.), engineer, 483, Glossop Road, Sheffield.—The following are creditors:—

Alexandre, P. C. G.	£55	Imperial Motor (1917) Industries Ltd.	£18
Broomhall Motor Co.	30	Radium Fire Extinguisher Co., Ltd.	15
City Tyre and Vulcanising Co., Ltd.	40	Vacuum Oil Co., Ltd.	12
Drive's, Ltd.	10	Ward, W.	14
General Electric Co., Ltd.	10	Retter, S. V.	15
Griffith Asbestos and Rubber Co., Ltd.	13	"Bankers"	21
Hather, H. & R.	62		

A. R. Meggett, electrical engineer, 45, Thrumpton Lane, East Retford.—The following are creditors herein:—

Mayall & Co., Ltd.	£133	Ward & Goldstone	£25
Overseas Engineering Co.	65	Bradford Armature Trading Co.	22
Premier Accumulator Co.	87	Sterling Telephone Co.	18
B.T.H. Co.	45	Haigh, Ben	40
Callender's Cable Co.	43	Hopkinson, Thos., & Son	18
Neecroft, J. A.	81	Teasdale & Humphreys	10
Sun Electrical Co.	31	Drake & Gorham, Ltd.	12

Company Liquidations.—New St. Helens and District Tramways Co., Ltd.—Meeting of members, September 24th, at 10, Dale Street, Liverpool, to hear an account of the winding up from the liquidators, Messrs. E. H. Edwardes and H. P. Conibear.

Graphite Plumbago Crucible Co., Ltd.—Meeting of members, September 21st, at 40 and 42, Queen Victoria Street, E.C., to hear an account of the winding up from the liquidator, Mr. E. Phillips.

Elieson Electric Traction Co., Ltd.—Meeting called for September 21st, at 25, Finsbury Square, E.C., to hear an account of the winding up, from the liquidator, Mr. J. Zillhardt.

Arthur Lyon & Wrench, Ltd.—Winding up voluntarily. Meeting of creditors, September 1st, at Victoria Road, Willesden Junction, N.W. Liquidator, Mr. R. J. H. Ryall.

Catalogues and Lists.—Marshall, Sons & Co., Ltd., Britannia Ironworks, Gainsborough.—A well-produced catalogue (36 pp.) dealing with "Marshall" high economy, superheated-steam semi-portable engines. Profusely illustrated by photographs.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—A 12-paged booklet, "Electric Vacuum Cleaners," describing various types of cleaners and accessories; also Leaflet No. H 2345, dealing with art-metal electric fires. Both publications are fully priced and illustrated.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Illustrated and priced leaflets dealing with house-service cut-outs and ironclad distribution boards of a new type.

"The Monthly Magazine" of Messrs. Higgs Bros., Sand Pits, Birmingham, Vol. II, No. 6 (pp. 24, figs. 4), September, 1920, comprises a price-list and stock-lists of D.C. motors of from 0·17 to 50 H.P., and of A.C. machines of from 1 to 35 H.P.

Messrs. Belling & Co., 3, Darby Road, Edmonton, N.—Two booklets illustrating and describing "Belling" fires, cookers, and other electrical domestic appliances.

Messrs. A. Emanuel & Sons, Ltd., 7, George Street, Manchester Square, W. 1.—Illustrated and priced preliminary folder dealing with electric light fittings. The firm is able to deliver from stock all the fittings illustrated in the finishes specified.

Messrs. Matthews & Yates, Ltd., Swinton, near Manchester.—Four illustrated and priced lists. Nos. 22/4 and 22/5 deal with D.C. "Cyclone" motors; No. 129 describes hot-air blast bottle-drying apparatus; and No. 131 deals with a compact and adaptable steam heater.

Messrs. Automatic and Electric Furnaces, Ltd., 281, Gray's Inn Road, W.C. 1.—Heat Treatment *Bulletin* No. 24: "Volume Changes in the Heat Treatment of Steel," by Dr. L. Aitchison.

The Benjamin Electric, Ltd., Tariff Road, Tottenham, N. 17.—Illustrated and priced interim list No. 515, containing illustrations of several newly-designed lighting fittings.

Trade Announcements.—The London Electric Stores, of Fulwood House, High Holborn, W.C. 1, have been appointed sole selling agents for Great Britain for the Electro Construction Co., of Wandsworth, London, manufacturers of ironclad fuseboards, &c.

The J. G. Brill Co. have removed from 110, Cannon Street, London, to 150, Southampton Row, London, W.C. 1. Telephone number: Museum 5313. Telegrams: "Axles, London."

The Cambridge and Paul Instrument Co., Ltd., has changed the address of its head office and showrooms to 45, Grosvenor Place, London, S.W. 1. Telegrams: Unipivot, Sowest, London. Telephone: Victoria, 7640.

Messrs. Murray Coombs & Richards, advisory and inspecting engineers, of Cross Keys House, 56, Moorgate Street, E.C., have been appointed representatives for the United Kingdom and Europe by Messrs. W. G. Watson & Co., Ltd., Sydney, Australia, and are moving forthwith to Premier House, 150, Southampton Row, W.C. Telephone No.: Museum 5303.

New Zealand's Electrical Imports.—The values of the imports of electrical goods into New Zealand from 1916 onwards were as follows:—1916, £474,455; 1917, £332,587; 1918, £343,395; 1919, £560,539.

Dissolution of Partnership.—S. Platt & H. C. Lawdham, Shenfield Garage, motor and electrical engineers, Shenfield, Essex.—Messrs. S. Platt & H. C. Lawdham have dissolved partnership. Mr. S. Platt will attend to debts.

Private Meeting.—H. H. Speke, electrical and motor engineer, 10 and 11, Queen Street, Wolverhampton.—A general meeting of the creditors in this matter was held on the 17th inst. in London, when the representative of Messrs. Hogan & Wardrop presided. The statement of affairs which had been prepared by Mr. D. E. Campbell, of Messrs. Campbell & Jordan, L.A., Wolverhampton, showed liabilities to unsecured creditors £2,900, and assets comprising stock in trade at estimated cost £5,634, plant, fixtures, and fittings £204, book debts £552, estimated to produce £450, and cash in hand and at bank £12, making a total of £6,300, from which had to be deducted preferential creditors £43, leaving net assets on the basis of a going concern of £6,257, or a surplus on this basis of assets over liabilities of £3,358. The statement also set out the assets on a realisation basis, and these totalled £3,900, or a surplus of £1,000. Mr. Campbell, in explaining the statement, said that the debtor started business 10 years ago, with a capital of £300, so that it was obvious from the figures which were now submitted that he had done a substantial business, and had made considerable progress since he started. In 1913 the sales were £623, in 1917 they had increased to £2,543, in 1918 they were £4,529, in 1919 £6,540, while for the period up to July 24th, 1920, they were £4,192. On the basis of a 25 per cent. gross profit the gross profits of the business would have been £1,132, £1,635, and £1,018 for the last three periods that he had mentioned. The expenses in 1919 were about £950. The net profits, which in 1913 were estimated at £84, gradually increased, and for the whole of the period under review totalled £2,486, against which the drawings had been about £1,100. Mr. Campbell stated that the only way in which he could account for the surplus was that the profit that the debtor had made had exceeded the figures that he had put down.

Mr. Poppleton said that whether they took it as a going concern or on a break-up basis, it was obvious that there was a very substantial surplus. He understood that the debtor was anxious to carry on the business, and it was clear enough that he was justified in this expectation. He had kept his books in an orderly way, and the only question for the creditors was to determine how the creditors were going to get their money. The debtor had executed an assignment, and a good many of the creditors had assented, and it was advisable that they should try and husband the business as far as possible.

Mr. Houston pointed out that the real decision come to at the previous meeting was that the debtor should consult his friends

with a view to a guarantee being found for the payment of 20s. in the £, spread over a period. Mr. Campbell stated that the debtor had not been able to find any guarantee.

Mr. Houston said that the real obstacle in the matter was the suing creditors, Messrs. Brown Bros., Ltd., who had obtained judgment, and it depended on what they were likely to do.

The representative of Messrs. Brown Bros. stated that his instructions were to "vote against everything," which led to the observation on the part of a creditor that this was not a very hopeful outlook.

One creditor said that the business had mostly been concerned with the motor trade. The trustee was asked what the stock consisted of, and he said that Mr. Speke dealt largely in electrical goods, and the stock comprised £3,113 worth of such goods, while there were tools to the extent of £1,661.

A lengthy discussion then ensued, during which many sympathetic remarks were made concerning Mr. Speke, several creditors expressing the view that he should be allowed to continue trading. In the result, a resolution was passed to the effect that a new deed of assignment should be executed to Mr. Campbell and Mr. G. G. Poppleton as trustees, with a Committee of Inspection consisting of some of the principal creditors. The estate, therefore, will be administered under this deed.

Threatened Coal Miners' Strike.—On Tuesday last the coal miners commenced to ballot for or against a national strike; their leaders expect a majority in favour of a stoppage, and foreshadow a strike within three weeks. There is no public sympathy with the miners, the disastrous results that would follow a strike being fully appreciated. The miners' demands are:—2s. a shift increase in wages, and a reduction of 14s. 2d. per ton on the price of household coal. The Government's reasons for refusing the demands are:—Coal is supplied to home consumers at the present cost of producing it, and the present profits on export coal belong to the country, and should benefit it through the Exchequer. The important dates in connection with the ballot are:—August 30th, ballot result; August 31st, Triple Alliance (miners, railwaymen, and transport workers) meet; September 2nd, strike notices to be handed in if ballot favours stoppage; September 18th, strike notices expire; and September 20th, strike to begin if decided upon. The Government is arranging to maintain, as far as possible, the essential services of the country in the event of a strike. The motor-transport services for the conveyance of foodstuffs, which were worked last autumn during the railway strike, would probably again be employed. In the event of a strike, export of coal would probably be stopped immediately, and the train services restricted. The Government is said to have already requested coal retailers to ration their customers evenly, allotting them only a proportion of their full orders. This week, Mr. Robert Smillie revealed the real reason for the demand for a reduction on the selling price of household coal. If this is taken off, many pits now producing coal for internal consumption will be unable to supply it except at a loss. Mr. Smillie says that this loss and the increased wages can be met out of the £65,000,000 profits that the State now takes from the export of coal. This means that the taxpayer will have to provide £66,000,000 in some other form of taxes, and, what is more—and this is said to be the real object of Mr. Smillie's demand—the whole machinery of State control over the coal industry will have to be reimposed. Mr. Smillie wants this as a prelude to nationalisation.

For Sale.—Mr. D. B. Nettleton will sell by auction, on September 6th, 7th, 8th and 9th, at Messrs. J. Whitley, Ltd. (in voluntary liquidation), Eagle Works, Well Lane, Halifax, an extensive engineering plant, including electric power and lighting installations, tools, &c.

Swansea Corporation electricity department invites offers for one 600-kw. d.c. Westinghouse generator with control panel direct driven by a marine type triple-expansion engine with circulating pump, &c.; also three Lancashire boilers complete. For full particulars, see our advertisement pages to-day.

The Overtime Ban.—The Manchester District Committee of the Electrical Trades Union gives notice that the men will not work overtime or on breakdowns, repairs of plant, or maintenance work generally, inclusive of meal times or on the usual holidays, until a satisfactory settlement is arrived at between the employers concerned and the Union.

The announcement that the Partington Steel and Iron Co., Manchester, which employs over 5,000 men and youths at its works on the Ship Canal at Irlam, has placed its employés on day-to-day employment, is now followed by the statement that other leading firms in Manchester and Salford will follow this example. Amongst others affected are Beyer & Peacock, Armstrong, Whitworth & Co., Crossley Bros., Hetherington's, Bailey & Co., and Jackson, Brookes & Doxey, who jointly employ over 30,000 men and youths. The refusal of the men to work overtime is a consequence of the rejection by the Industrial Court of an increase of 6d. an hour.—*Daily Herald.*

Belgium Recovering.—There is a fairly general belief in this country that Belgium is recovering from the ravages of war at a more rapid rate than any other of the late combatants, and an American commercial report from Brussels confirms this with some solid facts which might be brought to the notice of certain people in this country. "More work, more economy, and less paper money," we are told, are the dominant factors in the economic reconstruction of Belgium, and it is significant that the banks in their annual reports should agree that the first stage—more work—has been accomplished. Each day sees all classes of industries increasing their pre-war output, and the Belgian miners certainly show us the way in now producing at least as much coal as they did before the war.

Examinations in Electric Light Switching.—Sending us a special notice of the resumption of their plan of awarding money prizes in connection with their free examinations, Messrs. A. P. Lundberg & Sons comment severely on the action of the City and Guilds Institute in dropping the Ordinary-grade examininations in "Electrical Engineering" and "Electrical Installation Work," leaving only the Honours Grade, which will probably be discontinued also for want of support—for the entrants for the Honours Grade were the successful examinees in the Ordinary Grades. Messrs. Lundberg hold that efforts should be made to revive the examinations in the Ordinary Grades, under the control of some body more familiar with the practical requirements of the industry than the City and Guilds Institute or the Education Department.

In the meantime, their own examinations, to some extent, fill the gap, and they have doubled the total value of the prizes, besides increasing their number, the prizes in the three grades varying from £10 downwards; the aggregate value is £27.

L.W. Dynamos and Motors.—Having purchased the designs, jigs, tools and goodwill of the dynamos, motors, &c., of Messrs. Arthur Lyon & Wrench, Ltd., the firm of Todman, Ryall & Co., Ltd., 17, Victoria Street, S.W. 1, has been formed to carry on the manufacture and sales without a break. The actual manufacture is being undertaken by the Aircraft Manufacturing Co., Ltd. (proprietors, B.S.A., Ltd.), Hendon, N.W., in accordance with Messrs. Todman, Ryall & Co.'s designs, and solely to their orders. The machines are all tested by the company's engineers at the Air Co.'s works, and all parts are interchangeable with the A. L. & W. machines; the A. L. & W. staff engaged on the production has been largely transferred. Further supplies of machines and of spare parts can be obtained from the new company, a large stock being available.

Congratulations.—We are pleased to learn that a conference took place last week between representatives of the National Alliance of Employers and Employed and the Industrial League and Council, as a result of which it was agreed to recommend the amalgamation of these bodies. The Joint Executives will meet shortly to consider the report and to work out the details. There will then be created the most influential body of employers and employed which has ever existed in any country. Many leading employers and prominent Trade Unionists are connected with one or other of the amalgamating bodies, and the main object to be pursued will be the bringing together of Capital and Labour with a view to the avoidance of labour troubles, the joint consideration of matters appertaining to their industries, and the general industrial welfare.

Swedish Exports.—The imports of electrical machinery into Sweden in the first half of the present year were of the value of 7,128,000 kr., as compared with 954,000 kr. in the corresponding period of 1919. On the other hand, the exports of electrical machinery, which amounted to 4,116,000 kr. in the first six months of 1919, increased to 6,459,000 kr. in the corresponding period of 1920. The exports of telephone and telegraph apparatus, however, declined from a value of 4,672,000 kr. to 2,579,000 kr. in the same periods respectively.

Lead.—In their report dated August 21st, Messrs. G. Cawson & Co. say:—The market this week has not shown much change. Prices are 7s. 6d. to 10s. per ton dearer in all positions. There is still a premium of 5s. to 10s. per ton on forward lead. Closing prices are:—August and September, £35 15s. to £36; October and November, £36 to £36 5s. Prices have been maintained entirely by some further demand from the States. Although this demand is not important, it is at present sufficient to maintain prices. The home trade demand has entirely ceased for the present, and there has been some falling-off in the inquiry from electrical works, as there are serious indications of a strike, which may hold up consumption. Meanwhile, arrivals continue to come in freely, and there is a plentiful supply of lead.

The reports from producing centres continue satisfactory, and even Germany is now sending more lead to this country. So long as transport difficulties continue in the States, we may still expect some demand from that direction. The high price ruling there, however, will soon have its influence on American producers, and cause them to protect their own market against large imports of foreign lead. The settlement of the Australian strike appears to be imminent, although it will take them some time to get back to the pre-war output.

Messrs. James Forster & Co. say:—Large business has again been done for America this week, and we know that transactions up to at least 3,000 tons have taken place, most of the lead sold being for immediate shipment. This sort of thing has been going on for several weeks now, and we shall not be surprised if exports this month exceed the total imports.

German Heating Apparatus.—As an instance of the influence exerted by the German tax on exports, it is stated that while the home price of a certain size and type of electric heating apparatus is 45 marks, orders for export have to be accepted at 42 marks, as the apparatus otherwise is unable to compete. As, however, the exporters have to pay 8 per cent. export duty, and there thus only remains 38·60 marks, it is said that they are now no longer able to compete in external markets.

Meeting of Creditors.—*Re* JOHN SMALLWOOD, electrical engineer, 7, High Street, Hitchin.—Meeting of creditors held August 18th, Mr. Alfred Waters presiding, at Balfour House, E.C. 2. The statement of affairs as at August 18th, 1920, submitted by Messrs. Corfield & Cripwell, showed that there were liabilities of £752, and assets amounting to £719, leaving a deficiency of £32. It was stated that the debtor had been in the electrical trade a good many years. Early last year the business was handed over, free of all liability, to the son, H. W. Smallwood, returned from the Army, but the change was not a success. The debtor considered that the present position had been brought about entirely owing to the unsatisfactory management of the business by the son, who gave up some seven months ago. The father again assumed control; there was never any partnership arrangement between them. It was resolved at the meeting that the debtor should execute a deed of composition to Mr. W. Osborne, of Corfield & Cripwell, as trustee, he to discharge a composition of 16s. 8d. in the £ on terms to be determined by a committee of inspection.

Outing.—The Sheffield Electrical Social Union had a very enjoyable outing on Saturday, August 21st, when a party of members and friends, numbering 56, had a motor tour round the Dukeries. Tea was partaken of at the "Hop Pole" Hotel, Ollerton.

Book Notices.—"The Metropolitan-Vickers Gazette." Vol. VI, No. 88 (20 pp.).—The July issue of this interesting journal includes articles on "Labour in the United States," "An 80-ton Floating Crane," and "Electrical Characteristics of Transmission Circuits."

Circular No. 92 of the U.S. Bureau of Standards, "Operation and Care of Vehicle-Type Batteries" (94 pp.).—A very complete manual describing types of accumulators, the keeping of battery records, and proper operation.

"Text-Book of Engineering." By Dr. A. Thomalen, translated by G. W. O. Howe. Pp. xi + 482; figs. 480. London: E. Arnold. Price 28s. net.

"Industrial Control: The Application to Industry of Direction, Control, and Light." By F. M. Lawson. Pp. xiv + 130; 19 illustrations. London: Sir I. Pitman & Sons, Ltd. Price 8s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XXXIX. No. 8. August, 1920. New York: The Institute.

Conquest for August includes, amongst other interesting items, an article on "The Mechanism of the Thunderstorm," by W. Parkinson, dealing mainly with cloud forms.

The Chinese Electrical Market.—A recent trade report states that "electrical equipment" figures among the principal imports into Mukden (China); the Japanese at present have the bulk of the trade, while American electrical apparatus is being used in constantly-increasing quantities.

Electricians' Lock-Out Suspended.—The River Thames Dry Dock Proprietors and Ship Repairers' Association of the Port of London, which notified the E.T.U. that a lock-out of its members would commence on the 23rd inst., has suspended the notices as a result of informal meetings between the Union and the Association.

Swedish Electrical Companies.—Norrkoepings Elektrod Aktiebolag (Norrkoeping Electrode Co.) has decided to increase its share capital from the present kr. 825,000 to kr. 1,425,000 by the issue of new shares at par.—*Reuter's Trade Service.*

Motala Stroems Kraft Aktiebolag (Motala Electric Power Co.) has decided to increase its share capital by kr. 330,000, raising it from the present kr. 1,980,000 to kr. 2,310,000 by the issue of new kr. 1,000 shares at par.—*Reuter's Trade Service.*

LIGHTING AND POWER NOTES.

Australia.—NEW SOUTH WALES.—The Town Council of Wagga is considering an electricity scheme which is to cost £75,000, including £13,000 for reticulation.—*Reuter's Trade Service* (Sydney).

Birmingham.—ELECTRICITY SUPPLY.—Mr. E. J. Jennings, secretary of the Birmingham Electric Supply Department, has replied to complaints made last week in the Birmingham press, as to the inability of manufacturers to obtain sufficient electricity. He points out that the work of putting down the new generating plant has been greatly hindered by strikes and shortage of building labour. It was due to the Government embargo that the new Nichells power station was not put in hand sooner. Recently it had been found necessary to place restrictions on certain power users, owing to the breakdown of two large machines a few weeks ago. One of these machines, it was expected, would be again in commission in a fortnight's time, when the position would be somewhat eased. The other machine would not be ready for return to the Birmingham works for 10 weeks. The only consumers to whom it has been found necessary to limit supplies were those who contracted for a night supply only, and who had hitherto been allowed unrestricted supplies, or those who signed an undertaking not to make use of the supply during any portion of the day in which the department might find it necessary to curtail output. The department was not in a position at the present time to accept applications for new supplies.

Burnley.—EXTENSIONS DEFERRED.—The Electricity Committee has decided not to make any further extensions of electrical mains until it possesses adequate generating plant. The Council has already sanctioned the installation of further plant, but there is no possibility of this being in use next winter.

Canada.—NEW BRUNSWICK WATER POWER.—Plans for the development of Lepreaux River under the Water Power Act, passed at the last session of the New Brunswick Legislature, are being worked out.

At the Big Falls, where there is a head of 100 ft., the plans call for the development of 2,250 H.P. for a 24-hour day, and 5,000 H.P. for a 10-hour day. At the Lower Falls, where there is a head of 70 ft. at low tide, about two-thirds of the power of the Big Falls is available. Up the river there is the Ragged Falls with a head of 90 ft., making for the three falls a total head of 260 ft.

At the Big Falls the dam would be about 600 ft. long at the crest, and would give a pondage 6 miles long by an average breadth of 350 ft.—*Electrical News.*

STAND-BY PLANT.—The Hydro-Electric Power Commission of Ontario has given instructions to its engineering staff to install a 50,000-H.P. steam plant at a point which is yet to be determined, in time for the winter load of 1921-22. This will be in two 25,000-H.P. units. At the present moment a number of Hamilton sites are being considered.—*Electrical News.*

Celebes.—WATER POWER.—*Finance and Commerce* learns that preparations for opening up the immense deposits of iron ore and other minerals in the Celebes are going rapidly forward, the first business being to provide the water power from the adjacent lakes. In the meantime, says the journal, firms interested in the supply of machinery should be keenly on the watch for contracts for mining, smelting, and refining plant, electrical plant, and all sorts of accessories.—*Reuter's Trade Service* (Shanghai).

Chorley.—POWER STATION.—At the Rural Council meeting, on August 19th, a notice was read of a proposal to construct a generating station near Preston by the National Electric Supply Co.

Continental.—RUSSIA.—Prof. Lomonossow, head of the Russian Traffic Department, referring to plans of the Soviet Government for the unification of the electric power stations of Russia, said that three such stations were at present being formed—the first on the River Svir, which connects Lakes Ladoga and Onega; the second on the River Volkhov; and the third north of the Black Sea, on the Dnieper, between Ekaterinenburg and Alexandrovsk. An obstacle in the way of the unification of the electrical system was the shortage of water turbines, the only countries really able to deliver which were, the Professor is reported to have said, America, Germany, and Sweden.—*Reuter's Trade Service* (Berlin).

DANZIG.—The Danzig City Council recently approved a new scheme of charges for electricity, and the tariff adopted provides for a coal clause. The basis price for coal is 460 marks per ton delivered at the works, and the variation in the charge to the consumer will be 1 pfennig per KW.-hour for every variation of 2·50 marks in the coal price. The cost of production of electrical energy at Danzig has risen from 10·66 pfennigs per KW.-hour in 1913-14 to 122·05 pfennigs in 1920-21.

Dublin.—LABOUR DISPUTE.—Labour trouble at the North Wall Quay, Dublin, has involved the stoppage of electric lighting in the London and North-Western Railway Co.'s extensive premises there.

Dutch Indies.—WATER-POWER.—It is reported from Weltevreden, Java, that the Exploratie Maatschappij Assahan, which has obtained a concession to utilise the water-power of the Assahan River, is having plans for this purpose prepared in Europe. The company proposes to erect a large factory for the fixation of nitrogen.

Ince.—PUMPING PLANT.—The Urban District Council has applied for a loan of £9,000 for the provision of electrical plant at the Golborne pumping station.

Kilmarnock.—FLOODS.—A serious stoppage of the Kilmarnock generating station, last week, is reported by the *Glasgow Record*. It seems that the embankment of the river Irvine gave way, and the Corporation works were completely flooded, the water in the basement being 9 or 10 ft. deep, and a good deal of damage was done to plant. The supply of electricity was interrupted, and, in consequence, most of the public works in the town and throughout a large part of North Ayrshire had to close down.

London.—ELECTRICIANS' WAGES.—A settlement of the dispute between the L.C.C. and its electrical workers was arrived at early this week, at a conference between the Highways Committee and the London District Committee of the E.T.U. It is claimed that an average of 2d. per day less than the average district rate has been paid by the L.C.C. for the last month.

Mullingar.—ELECTRIC LIGHT PROPOSALS.—The Town Commissioners have directed the Clerk to communicate with local firms who might be willing to submit proposals for the installation of public electric lighting.

New Zealand.—Hydro-Electric Scheme.—The Municipal Council at New Plymouth has supplied the following particulars of proposed extensive additions to the local hydro-electric scheme :—

The completed scheme provides for an intake on the Waiwakaiho River and the conveyance of the water up to a maximum of 200 cb. ft. per second by means of a tunnel into the valley of the Mangamahoe Stream.

The construction of a weir across the Waiwakaiho River at the intake to the tunnel for the purpose of raising the head of water at the tunnel.

The building of a dam across the Mangamahoe Stream, to impound the waters of the Mangamahoe, and also the Waiwakaiho, in a storage reservoir having an area of 95 acres, and a capacity of 50,000,000 cb. ft., with a 15 ft. draw-off.

The building of two embankments on the south side of the proposed reservoir to prevent the water overflowing the adjacent lands.

The construction of a second tunnel to convey the water from the storage reservoir to the forebay overlooking the power house. The construction of a forebay or surge chamber, also the laying of three penstock pipes 5 ft. internal diameter supported on concrete cradles, together with all necessary expansion joints, anchors, &c., also the conveyance of the water from the termination of the 5-ft. penstock pipes by branch pipes to the various units at the power house.

The units when the full power of the station is in use will be as follows :—Two of 1,000 H.P., two of 1,500 H.P., and two of 2,000 H.P.

The construction of a new power house consisting of generator floor, switchboard platform, workshop, shift room, telephone office, together with tail race to link up with the existing tail race and enlargements of the latter.

The estimated cost of the complete scheme is £233,308, excluding present works, transmission, and reticulation, the capital cost of which to date is £87,500.

It is not intended to proceed with the whole of the scheme at present, but work to the value of £112,000 is to be carried out. The complete scheme will be sufficient to meet the needs of the provincial district of Taranaki for many years.—*Reuter's Trade Service* (Wellington).

North-East Lancashire.—Electricity District.—Burnley and other authorities in North-East Lancashire have decided to appeal against their inclusion in the mid-Lancashire district, under the electrical supply scheme. They consider the supply of electricity in the area would be more economically and efficiently controlled by an authority having jurisdiction in North-East Lancashire only, instead of one running from Colne to Blackpool.

Price Increases.—It is proposed to increase the charges for electricity at Huddersfield, and also in the Twickenham and Teddington district.

Rawtenstall.—Electricity District.—The Corporation has passed the following resolutions :—(1) That having regard to the serious financial responsibility which would be involved, this Corporation protests to the Minister of Transport against the proposal that the said Minister should erect a generating station on the south bank of the River Ribble at Preston.

(2) That this Corporation strongly objects to being included in the proposed mid-Lancashire electricity district on the ground that the supply of electricity in this borough can be more economically and efficiently controlled by an authority having jurisdiction in North-East Lancashire only.

South Africa.—Simons Town.—Sanction to the proposed expenditure of £10,000 on the electricity undertaking is to be asked for next week.

Warrington.—Loan Sanctioned.—The Town Council has received the sanction of the Ministry of Health to borrow £130,000 and £34,892 for the purposes of the electricity undertaking.

TRAMWAY AND RAILWAY NOTES.

Burnley.—Ban on Overtime.—The town was again without a service of cars on Sunday, August 22nd, owing to the embargo on overtime imposed by the Engineers' Association. There was a conference between the parties on August 21st, but it was without successful results.

Cardiff.—Strike.—On Monday, August 16th, 300 employés of the Corporation tramway repair department ceased work in consequence of the Corporation's refusal to grant them the district builders' rate of 2s. 1d. per hour. The majority of the employés in other municipal departments ceased work in sympathy. The power station was kept running by means of voluntary labour.

Dublin.—Proposed Fare Increase.—The Dublin United (Electric) Tramways Co. (1896), Ltd., has applied to the Minister of Transport for an order under the Tramways (Temporary Increase of Charges) Act, 1920, authorising an increase in the maximum fares chargeable on the system, which covers the whole of Dublin, and parts of Rathfor, Rathmines, and Pembroke. Apparently, the long-distance routes—to Kingstown and Howth—are not to be included. The areas included have at present 1d. and 2d. fares, and the proposed revised charges are to be 1½d., and 3d. The 1½d. fare to apply as a maximum from any of the city termini to the city boundaries as existing in 1897.

Glasgow.—Strike.—The 24-hours' strike against the increases of rent sanctioned by the Rent Act, began on the 23rd inst., and the city seemed almost tramless. On most of the usual routes the ordinary services were suspended, and the few that were kept going were irregularly served. Beyond the absence of tramcars, there was little sign that a strike was in progress, other trades being opposed to it.

Edinburgh was also without a tramway service.

Hull.—Year's Working.—The working of the tramways during the past year has resulted in a loss of £9,646.

Japan.—Railway Electrification.—The Banshu Hydro-Electric Railway Co. is going to extend its line a distance of seven miles from Shingu, Ibo district, Banshu, to Yamasaki, Shiso district, in the same province. The work is estimated to cost 1,250,000 yen.

In connection with the scheme for the electrification of railways in Japan, it is proposed to build a power station at Ojiya, on the Shinano river, capable of producing 250,000 H.P., at a cost of about 100,000,000 yen. The project is to be laid before the present extraordinary session of the Diet for approval.—*Reuter's Trade Service* (Tokio).

Mono-rail System.—Traffic congestion in the streets of Tokio has led a number of business men to approach the Government for permission to build an electric mono-rail line over the rivers and canals. The scheme proposes to use cars accommodating 50 passengers, and the average speed is put at 25 miles per hour. A company is to be formed with a capital of $7,500,000, and the estimated cost of the undertaking is $815,000 per mile.

Leeds.—Tramway Losses.—The Corporation tramways are still running at a loss, though this is less than in the early part of the year. The average deficit per day during July is recorded to have been £158, as against an average of £228 during the four months April-July. The receipts per car-mile during the period of the July report were 24·10d., with an expenditure of 25·45d., so that the total deficit during the month was £4,418. The receipts were higher by £12,001, in consequence of the increase of fares, than during the corresponding month last year, but the increase has not met the increased expenditure. There was a decrease in the number of tickets used since the increase in fares, especially for short distances.

Liverpool.—Work for Ex-Service Men.—Liverpool Tramways Committee contemplates building a carriage works to find work for unemployed ex-Service men.—*The Times.*

London.—New Trains.—Within the next three weeks the first of the new trains, with extra doors to allow quick filling and emptying, will be run on the District Railway, and about another dozen will be introduced by the winter.

Cheap Mid-Day Fares.—The concession granted by the L.C.C. to tramway passengers during the slack period of the day, a maximum of 2d. for any distance, is under consideration for withdrawal. Although this concession has proved satisfactory to the L.C.C., the omnibus companies regard it as detrimental to their interests, and offer to charge only 1d. for 6 mile if it is withdrawn. A resolution embodying this suggestion was submitted to the Council by the Highways Committee, but was rejected by the Council at a special meeting on Tuesday last.

Nelson.—Wages Settlement.—A settlement has been reached in the wages dispute, which threatened to cause the tramway workers of Nelson and Colne to cease work. The local Tramways Committee has decided to adopt Grade I. scale of ¼d. per hour increase.

New Zealand.—Coal Shortage.—Owing to the coal shortage, brought about by the waterside men's dispute, Wellington is practically in darkness, and no tramcars are running.

Rawtenstall.—Extensions, &c.—The Town Council, on August 19th, resolved that the plan be approved of the new tramcar shed to be erected on Longholme Meadow and relaying of the tramway track to be laid out on Bacup road; also resolved that the estimate of Messrs. Hadfields, Ltd., Sheffield, be accepted for the laying of the tramway track, and that of Messrs. Lambourne and Co., Ltd., steel constructing engineers and contractors, Openshaw, Manchester, for the builder's work. It was further resolved that application be made to the Ministry of Transport for permission to borrow £2,690 for laying tramway track, £11,750 for the erection of the building, and £30,000 for the purchase of eight new tramcars already ordered.

Southampton.—Strike Settled.—The strike of tramway workers, which lasted nine days, was settled on Monday. The Town Council agreed to submit the case of the conductor who was dismissed, to a joint industrial council.

Sunderland.—Year's Working.—There is a net balance of £26,000 on the working of the tramways during the past year. Altogether a sum of £77,000 has been contributed to the relief of the rates.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Telephones.—Preparations are being made to introduce an automatic telephone system at Fleetwood. The work is expected to be completed by February next.

Brazil.—New Telephone System.—The Board of Trade Department of Overseas Trade informs us that information has been received from the British Chamber of Commerce of Sao Paulo and Southern Brazil to the effect that it is proposed by the Government of the State of Alagoas to install a complete telephone system, and it is suggested that interested firms should send their representatives to Alagoas to study the requirements on the spot, unless, of course, they have agents in that district. The contract excludes the city of Maceio, and the concessionaires must undertake to connect at least 12 municipalities within two years after the signing of the contract, and the remaining municipalities within a further period of two years. The maximum time for the concession to run is 25 years. The Governor is empowered to permit the concessionaries to utilise waterfalls for the furnishing of electric energy, and to concede to them the necessary importation of material free of duty. Before becoming effective, any contract must be submitted to the State Legislature for approval and sanction. The official decree (in Portuguese) may be seen by interested parties on application to the Department (Room 48; Captain Vandeleur).

Colombia.—Wireless Telegraphy.—In March, 1919, the Colombian Government contracted with Marconi's Wireless Telegraph Co., Ltd., for the construction of a large wireless station at Bogota, and this has now been followed by an additional contract for the construction of a similar station near Barranquilla. At present the latter place is suffering badly from lack of cable accommodation, notwithstanding that it is Colombia's chief port of entry, and the distributing point for a large portion of the interior. There is, for instance, no direct service to Colon, Panama, in order to make connection with the cables of the Central and South American Cable Co. to New York and London. All messages for Colon must be transmitted *via* Bogota to Buenaventura, where there is a cable station. This means that the messages must be sent over approximately 2,000 miles of single wires in the rough interior of the country, and they are often delayed for more than a week. According to an American commercial report, plans are being made also to improve the cable service.

Combined Wire and Wireless Telephony.—Business messages between the London offices of a commercial firm and a passenger-carrying aeroplane owned by the firm on its way to France, were exchanged on Thursday last week by a combination of the ordinary and wireless telephones. According to *The Times*, after the machine had flown away from Croydon aerodrome, it was found to be urgent to convey some special instructions to the pilot. The Air Ministry was communicated with and assisted in connecting the firm's office telephone with the wireless installation at Croydon, and spoken communication was obtained by the combined telephones. At one point in the conversation, communication was interrupted at the telephone exchange, and was restored again in the ordinary way after conversation with the operator there.

Germany.—Wireless Telegraphy.—Negotiations have taken place in Berlin with regard to the restoration of direct wireless communication with America for private traffic, but until a state of peace is established, says *The Times*, the traffic will, as hitherto, be dealt with by the American naval station.

Cable Propaganda.—The Imperial Ministry of Posts announces that an agreement has been negotiated with the (American) Hearst newspaper combination, and also with another American group, intended to promote the development of German international cable traffic.

Ireland.—Wireless Station Burned.—The coast-guard station at Browhead (Co. Cork), which was also a Lloyd's signal station, and which was raided less than a fortnight ago, was burned to the ground on the night of August 20th by armed men, who carried off a quantity of stores.

Sinn Feiners added to their wireless equipment by a raid on Dunfanaghy (Co. Donegal) post-office, on August 18th, when they took away telegraph and telephone instruments and a wireless set.

Several wireless stations on the Irish coast have been attacked in the past fortnight, and damage caused to them. In some places inland, wireless stations have been got into operation at military centres so as to control news when ordinary telegraph and telephone lines are destroyed.

Jamaica.—Telephone Extensions.—The telephone system is, for the most part, confined to Kingston, and although the Governor of the Island has recently suggested to the Council the desirability of an expert investigation with a view to extending the system to the whole island, he did not succeed in achieving his object. The present equipment comprises some 600 instruments and 400 miles of double wire, and is of American make. An American commercial report recommends American firms to approach the Council on the question of extending the system.

Japan.—Naval Wireless.—The Japanese Navy will no longer depend upon wireless telegraphy, says the *Wireless World*, the perfection of wireless telephony having induced the Ministry of the Navy to recognise this latter system before all others. Wireless telephony has already been installed in vessels of a unit of the First Squadron, and the remainder of the fleet is to be similarly equipped.

New Cable.—Dairen-Nagasaki.—A new telegraph cable is to be laid between Dairen and Nagasaki, the route being alongside of the South Manchurian Railway. According to an American Consular report, the Japanese Government will provide and lay the cable, and bear the expenses of upkeep, but the cost of laying will be borne by the railway company, the Japanese Government paying 7 per cent. per annum on this cost, so long as the Government continues to use the cable. The total cost is put at $1,350,000. All the materials have been ordered in England, for delivery by November, 1920, and the work is due for completion in March, 1921.

Telegraph Service.—Wireless Services.—The only public wireless services at present in operation to Continental countries are those of Spain, Norway, Denmark, and Sweden, stated Mr. Illingworth in Parliament last week. The question of providing similar services to other Continental countries, including France, is under consideration.

Increased Rates.—The advance in telegraph rates to 1d. per word with a minimum charge of 1s. will come into operation on Wednesday next.

West Indies.—Cable Delays.—Telegraphic communication, during and since the war, has been in a chaotic condition in most parts of the world, but nowhere has it been worse than in the West Indies. Recently messages to the Islands could only be accepted at sender's risk, and subject to heavy delay. Government-owned and worked wireless stations, erected for war purposes, endeavoured to conduct a commercial service unsuccessfully, and such a result, under the circumstances, can only be regarded as natural. The whole telegraphic system is in need of overhauling. In this connection, various resolutions were passed by the Chambers of Commerce in the West Indies, and the Ninth Congress of Chambers of Commerce of the British Empire had a resolution on its agenda for the gathering at Ottawa. The opportunity should also be taken to free the West Indian telegraphic systems from foreign control.

Wireless Station Closed.—An Admiralty notice to mariners states that the Lizard wireless direction-finding station has been temporarily closed, and mariners are warned that the station will be out of action until further notice.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes. Specifications &c., will be available at Australia House, Strand W.C.—*Reuter's Trade Service.* (Brisbane).

Victoria.—October 20th. Victorian State Rivers and Water Supply Commission. Two 1,600-B.H.P. steam turbines, with mechanical reduction gearing and condensing plant.—*Reuter's Trade Service* (Melbourne).

Birmingham. — September 1st. Salvage Committee. Two 100-KW., 440-V., D.C., compound-wound, steam-driven generating sets, complete with surface condenser and switchboard. (July 30th.)

Bolton.—September 16th. Electricity Department. One 12,000-KW. turbo-alternator. (August 20.)

Bradford. — September 9th. Electricity Committee. Contract R. 159. No. 4 boiler house and equipment, including buildings, water-tube boilers, economisers, induced-draught plant, feed pumps, coal-handling plant and piping systems. (August 6th.)

Croydon. — September 8th. Tramways Department. Supply and installation of a new feeder cable. (August 13th.)

Edinburgh.—September 6th. Electricity Department. Converting plant for Portobello generating station and sub-station. Specification No. 26. (August 6th.)

September 7th. Corporation. Electric lighting installation at the Public Health Offices, Johnstone Terrace. Plans at Engineer's Office, Dewar Place.

India. — Agra. — October 22nd. Municipal Board. Complete generating plant, comprising: four Diesel engines and H.T. alternators; H.T. and L.T. switchgear, transformers and sub-station equipment; 15 miles underground H.T. cables, 28 miles overhead L.T. three-phase mains and street lighting equipment, complete with all accessories. (August 20th.)

Langho (near Blackburn).—September 15th. Manchester Board of Guardians. Replating a battery of accumulators (98 cells), at the Epileptic Colony, for the Manchester Union. Further particulars from Medical Superintendent at the Colony.

London.—St. Pancras.—September 14th. Electricity Department. Two water-tube boilers, each of 40,000 lb. per hour evaporation. (See this issue.)

Macclesfield. — September 13th. Cheshire County Asylum. Supply of electrical goods. Mr. W. F. Tingay, Parkside Asylum.

Manchester. — August 30th. Electricity Committee. Barton power station: 33,000-volt, 3-phase trunk feeders (26 miles), pilot cables (104 miles), telephone cables (19 miles). Specification B, 7. (August 6th.)

September 2nd. Markets Committee. Pumps, motors and fittings, for Smithfield and Elm Street cold stores. Specifications, &c., from General Superintendent, Markets Department, Town Hall.

September 14th. Corporation Tramway Committee. Steel girders, tramway rails, permanent way special track work. Mr. J. M. McElroy, General Manager, 55, Piccadilly, Manchester.

September 20th. Electricity Committee. Six 33,000-volt, 19,500 K.V.A., 3-phase static transformers, house service and testing transformers. (August 6th.)

Merthyr Tydfil.—September 6th. Electrical fittings for six months for the Board of Guardians. Mr. F. T. James, Clerk. High Street.

Nuneaton.—September 20th. Electricity Department. H. and L.T. switchgear, connecting cables and accessories. (August 13th.)

South Africa.—Johannesburg.—September 6th. Gas and Electric Supply Department. Class A. One or more light electric passenger vehicles. Class B. One or more light electric delivery vehicles. (August 13th.)

Stockton-on-Tees.—August 30th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (August 13th.)

Uganda.—December 20th. Government of the Uganda Protectorate. Tenders invited for a concession of a portion of the Ripon Falls of the Nile. See this column in our issue of July 30th.

Walthamstow.—September 8th. Urban District Council Electricity Department. Two water-tube boilers and economisers; one 5,000-KW. turbo-alternator and condensing plant; one 1,500-KW. and one 1,000-KW. rotary or motor converters; one natural-draught cooling tower; E.H.T. and L.T. switchgear; E.H.T. cables. (August 13th.)

Warrington.—September 7th. Electricity and Tramways Committee. Surface condensing plant. (August 6th.)

West Ham.—September 9th. Board of Guardians. Electrical fittings for six months. Mr. T. Smith, Clerk to the Guardians, Union Road, Leytonstone, E. 11.

CLOSED.

Bridgwater.—Town Council :—

H. West & Son, Electric light installation, Municipal Buildings, £485.

Colchester.—Board of Guardians :—

Truslove, Ltd., Electric light installation at the Infirmary, £66.

Government Contracts — The following Government contracts have been placed during July, 1920 :—

Admiralty (Contract and Purchase Department).

Electric cables.—Johnson & Phillips, Ltd.
Internal electric lighting and power wiring.—Foot & Milne.
Lampholders.—Edison Swan Electric Co., Ltd., W. McGeoch & Co., Ltd., C. H. Parsons, Ltd., Rainsford & Lynes, Ltd.
Electric navigation and fishing lanterns.—Troup, Curtis & Co., Ltd.
Electric radiators.—General Electric Co., Ltd.
Carbon rods.—Morgan Crucible Co., Ltd.
Equipment for dealing with turbine blading.—J. Brown & Co., Ltd.

War Office.

Electric cells.—Siemens Bros., Ltd.
Magneto spares.—Lucas Electrical Co.

Post Office.

Protective apparatus.—Automatic Telephone Manufacturing Co., Ltd., British L. M. Ericsson Manufacturing Co., Ltd., Phœnix Telephone and Electric Works, Ltd., Western Electric Co., Ltd.
Telegraph apparatus.—Siemens Bros. & Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd., Peel-Conner Telephone Works, Ltd., Phœnix Telephone and Electric Works, Ltd., Siemens Bros. & Co., Ltd., Sterling Telephone & Electric Co., Ltd., Western Electric Co., Ltd.
Testing apparatus.—British L. M. Ericsson Manufacturing Co., Ltd., International Electric Co., Ltd.
Battery boxes.—W. Duncan, Tucker & Sons, Ltd.
Submarine cable.—Telegraph Construction & Maintenance Co., Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd., Johnson & Phillips, Ltd., London Electric Wire Co. & Smiths, Ltd., Macintosh Cable Co., Ltd., Pirelli General Cable Works, Ltd., Union Cable Co., Ltd., Western Electric Co.
Distribution cases.—H. White & Co., Ltd.
Casing and cover.—W. Duncan, Tucker & Sons, Ltd.
Joint box castings.—Falkirk Iron Co., Ltd., Finedon Foundry Co., McDowall, Steven & Co., Ltd.
Compound.—Dussek Bros. & Co., Ltd.
Conduit.—Brotherton Ediswan Tubes & Conduits, Ltd.
Cords for telephones.—London Electric Wire Co. & Smiths, Ltd., Phœnix Telephone & Electric Works, Ltd.
Ducts.—Albion Clay Co., Ltd., Doulton Iron Co., Ltd., Hepworth Iron Co., Ltd., J. Oakes & Co.
Electric light fittings.—Edison Swan Electric Co., Ltd.
Telegraph ironwork.—Bayliss Jones & Bayliss, Ltd., Bullers, Ltd., C. Richards & Sons, Ltd.
Electric hand lamps.—Benjamin Electric, Ltd.
Jointing sleeves.—C. M. Fowell Bros.
Lead tube.—T. & W. Farmiloe, Ltd.
Insulated bronze wire.—Johnson & Phillips, Ltd.
Enamelled and silk covered copper wire.—British Insulated & Helsby Cables, Ltd.
Leclanche rod zincs.—Eyre Smelting Co., Ltd., Siemens Bros. & Co., Ltd.
Laying conduits, &c.—Paisley-Greenock (Section I): Casey & Darragh, Ltd. (Section II): Westminster Public Works, Ltd. Amersham and Hull-Grimsby: Hodge Bros. (Contractors), Ltd. City of London, Gerrard-East Junction, London-Bristol-Newport (S. Midland, Section VII and Section VIII): J. Mowlem & Co., Ltd. Chester-Hawarden: A. R. Cleghorn.
Manufacture, supply, drawing-in and jointing cable.—Hop-Victoria Junction: W. T. Henley's Telegraph Works, Ltd. Greenwich-East Junction: Western Electric Co., Ltd. London-Southampton (Guildford-Southampton) Section: Siemens Bros. & Co., Ltd.
Posting box band conveyor.—Glasgow H.P.O.: G. Robson & Co. Sub-contractors for motor and starting switch: Veritys, Ltd.
Power plant.—Leicester Telephonic Repeater Station: Western Electric Co., Ltd. Sub-contractors for batteries: Pritchett & Gold & E.P.S. Co., Ltd. For charging machines: Electric Construction Co., Ltd.
Repairing battery.—Central (London) Telephone Exchange: Chloride Electric Storage Co., Ltd. Stockport Telephone Exchange: Tudor Accumulator Co., Ltd.
Telephone exchange equipment.—Birmingham (East) and Stratford: Western Electric Co., Ltd. Sub-contractors for charging machines: Crompton & Co., Ltd. For batteries: Tudor Accumulator Co., Ltd. East (London) and Wembley: Western Electric Co., Ltd. Sub-contractors for batteries: Chloride Electric Storage Co., Ltd. For charging machines: Electric Construction Co., Ltd. Lee Green and Liverpool (Bank): Western Electric Co., Ltd. Glasgow (Central) and Dundee: Peel-Conner Telephone Works, Ltd. Sub-contractors for batteries: D. P. Battery Co. For charging machines: Crompton & Co., Ltd. Weymouth: Siemens Bros. & Co., Ltd. Sub-contractors for batteries: Hart Accumulator Co., Ltd. For charging machines: English Electric Co., Ltd. Hamilton, Winchester and Ascot: Siemens Bros. & Co., Ltd. Sub-contractors for batteries: Pritchett & Gold E.P.S. Co., Ltd. For charging machines: English Electric Co., Ltd. Ballsbridge (Dublin): Siemens Bros. & Co., Ltd. Sub-contractors for batteries: Tudor Accumulator Co., Ltd. For charging machines: English Electric Co., Ltd.

India Office: Store Department.

Ringing apparatus.—Western Electric Co., Ltd.
Batteries, &c.—Siemens Bros. & Co., Ltd.
Fuse boxes.—Callender's Cable & Construction Co., Ltd.
Cable.—Callender's Cable & Construction Co., Ltd., W. T. Glover & Co., Ltd., Siemens Bros. & Co., Ltd., Union Cable Co.
Artificial Cable.—Telegraph Condenser Co., Ltd.
Crucibles.—Morgan Crucible Co., Ltd.
Cubicles.—Ferguson, Pailin, Ltd.
Generating sets.—Lancashire Dynamo & Motor Co., Ltd.
Lamps.—General Electric Co., Ltd., J. Lucas, Ltd., Rownson, Drew & Clydesdale.
Searchlight parts.—Chance Bros. & Co., Ltd.
Unit switch.—Erskine Heap & Co., Ltd.
Transformers.—British Electric Transformer, Ltd.
Wheatstone receivers.—Elliott Bros., Ltd.
Copper wire.—T. Bolton & Sons, Ltd.

Crown Agents for the Colonies.

Electric travelling crane.—Stothert & Pitt, Ltd.
Electric light fittings.—J. Stone & Co., Ltd.
Motors and switchgear.—British Thomson-Houston Co., Ltd.
Telegraph switchboards, &c.—British L. M. Ericsson Manufacturing Co., Ltd.
Telephone material.—Western Electric Co., Ltd.
Telegraph line matgrial.—Bullers, Ltd., Siemens Bros. & Co., Ltd.
Telephones.—British L. M. Ericsson Manufacturing Co., Ltd.
Telephone line material.—Bullers, Ltd.
Copper wire, &c.—Shropshire Iron Co., Ltd.
H.D. copper wire, &c.—Shropshire Iron Co., Ltd.
Galvanised iron wire.—Shropshire Iron Co., Ltd.

H.M. Office of Works.

Engineering services.—Epsom Ministry of Pensions, storage battery: Premier Accumulator Co., Ltd. French Institute, South Kensington, electric wiring: Alpha Manufacturing Co., Ltd. Manchester Ministry of Pensions, electric lift: Marryat & Scott, Ltd.

Board of Public Works, Dublin.

New public offices, Dublin, electric lifts: Gimson & Co., Ltd. Electric lighting: V. G. Middleton & Co.

Stirling.—Town Council :—

Electric lighting, Shiplaugh houses, W. & T. Marshall & Lockhart and Macnab, £1,629.

FORTHCOMING EVENT.

Machine Tools & Engineering Exhibition at Olympia, W. 14.—Saturday September 4th to Saturday, September 25th.

NOTES.

Electrical Research Association. — The Electrical Research Committee is about to be registered at the Board of Trade as an Association with the object of promoting research work in the electrical and allied trades, and with power to establish laboratories and carry on experiments to that end. The Committee was established in 1917 to take over all investigations initiated by the I.E.E. and the B.E.A.M.A. A research scheme has been approved by the Department of Scientific and Industrial Research, which department will make grants when registration has been completed; this should add scope and value to the Association.

Appointments Vacant. — Overhead linesman (84s.) for the Burton-on-Trent Corporation electricity and tramways department; foreman telephone linesman (£250 + £30 + 20 per cent.) for the Government of Fiji; junior shift engineer for the Borough of St. Marylebone electricity department. See our advertisement pages to-day.

Portable Electric Drill.—One of the latest developments of post-war activities in shipbuilding has been the perfecting of a special device for countersinking ship plates. Button-head rivets on the bottom of vessels tend to retard the speed of ships; they also pick up obstructions such as sea weed, &c.; consequently, the order went forth that these rivet heads should be countersunk, so that the surface would be perfectly flat, making a rustproof and airtight joint. The machine designed for countersinking is 22 in. long, weighs 125 lb, and takes direct current at 220 volts. Its maximum speed is 125 R.P.M. It will countersink holes up to 1 in. in diameter. It is claimed that a ¾-in. hole can be countersunk in 7 seconds. In operation the plates are laid out on the floor, and in this position it is a simple matter to pass the buggy, on which the drill is mounted, from one hole to another as the work progresses. *American Machinist.*

Kinema Eye-strain.—The Joint Committee appointed by the Illuminating Engineering Society, on which the kinematograph industry, the Council of British Ophthalmologists, and the Physiological Society were represented, and to which several L.C.C. officers gave assistance, recently presented its report on eye-strain in kinematograph theatres to the L.C.C. Undue proximity of seats to the screen, which causes fatigue due to the upward tilt of the eyes, is the chief point dealt with. It is suggested that the "angle of elevation" of vision to the top edge of the pictures should not exceed 35°; a limit is also set to the lateral angles of view to the side edges of the pictures. Other questions considered include the effect of flicker and defects of film and projecting apparatus. It is explained that by suitable distribution of diffused light, sufficient artificial illumination can be provided during the performance without detriment to the appearance of the picture.

Fatalities.—Whilst engaged in repair work on the signal lines alongside the Manchester-Bury electric railway, on the 19th inst., Walter Eckerley, aged 20 years, received a shock in consequence of a signal wire coming in contact with the electric line. He was severely burned all over the body, and died the same evening.

At an inquest, last week, on George Fletcher (62), of Halifax, for the past 43 years a railway telegraph wireman, a verdict of "Accidental death" was returned. He died from injuries received whilst soldering a connection to an earth wire, a train of trucks passing over his leg. He had no look-out man at the time, though he had had one the previous day.

A public inquiry was held, on Friday, in the Justiciary Buildings, Glasgow, regarding the death of Duncan Wilson Hardie, electrician, 2, Firpark Terrace, Govan. Hardie, a son of the late Mr. Keir Hardie, had been reading a meter in the engine-room at Port Dundas electric power station, on May 13th, when an explosion occurred and blew out the meter. Hardie was severely burned about the face, and was removed to hospital, but died on May 31st. A formal verdict was returned.

Induction Frequency Changers.—With reference to our note under the above heading, on page 215 of our last issue, Captain William P. Durtnall points out that the system of frequency changing or variable frequency generation, as described, is the subject of his American patent No. 1,098,345, dated May 26th, 1914, and resulted from experiments in the development of his well-known "Paragon" polyphase A.C. power transmission system for ship propulsion, railway traction, and other industrial applications of thermo electrical energy.

Meteorological Forecasts.—The Air Ministry, in an official *Notice to Airmen*, issued on August 19th, details innovations recently introduced in the dissemination of meteorological statistics and forecasts by wireless telegraphy for the use of aircraft. According to *The Times*, reports are issued from the Croydon aerodrome on a 900-metre continuous wave each day, including Sundays, at hourly intervals between 7.35 a.m. (G.M.T.) and 4.35 p.m., the data in each consisting of observations made 35 minutes previously at the following places:—Felixstowe, Croydor, Biggin Hill, Lympne, Beachy Head, Dungeness, and Botley Hill (North Downs). In addition to the usual information, the messages now include the direction and speed of the low clouds, the character of the sea-swell, and the visibility towards the sea as distinguished from that over the land, the latter important feature being observed at various points along the Channel coast. A statement is also added regarding the conditions prevailing on the North Downs as viewed from Biggin Hill, while at 8.35 a.m. the complete results of a pilot-balloon ascent at Croydon or Lympne are appended whenever available. Every statement is suffixed by the latest Meteorological Office estimate of the probable weather during the remaining hours of daylight. Reports of a similar character are also issued on the same wave-length from Le Bourget seven times daily, the observations transmitted in this case being derived from St. Inglevert, Abbeville, Maubeuge, Havre, and Le Bourget.

The E.T.U. and the "Daily Herald."—The Electrical Trades Union, apparently anxious to render the *Daily Herald* independent of Bolshevik subsidies, has decided by a ballot vote to invest £3,000 in the *Herald*.

In a message of July 30th from M. Chicherin (the Bolshevik Foreign Minister) to M. Litvinoff, the former said:—"If you have not enough ready money for the subsidy to the *Herald*, tell him at any rate the subsidy will be paid by those who have authority to organise the financing of our institutions abroad."

The editor, Mr. Lansbury, states that he has not received any subsidy from the Bolsheviks; but which Bolsheviks does he mean?

The E.T.U. and the Housing Problem.—We have received from the Electrical Trades Union, No. 11 Branch, Plymouth, a copy of an admirable letter addressed to the members of the local Housing of the Working Class Committee. The letter urges that electricity be installed in all the houses that are being built on the estates at Mount Gold and North Prospect; that all roads and avenues, &c., be illuminated by electricity; and that the Committee authorise the installation of electricity in all houses and flats under its control.

In support of the application, it is pointed out that the medical profession affords ample evidence that for general sanitation electricity fills a very important position, helping materially to lessen the inroads of disease, aggravated by an overheated and impure atmosphere. It is regarded as a scandal that whilst every endeavour is made to install electricity in hospitals, public buildings, &c., for hygienic purposes, very little progress has been made at Plymouth towards obtaining this benefit in the people's homes. Further, houses fitted with electricity for illuminating and cooking only require renovating every 10 years; with gas they require renovating every two years, and the original outlay is recovered in a few years on this item alone. Chimneys, grates, &c., can be abolished, resulting in increased cubic capacity of rooms, and a great saving can be effected in the erection of houses. Last, but not least, the cause of mothers and housewives is pleaded, for electricity supply without any doubt will reduce to a considerable extent the drudgeries of those who have to toil an untold number of hours. The Electrical Trades Union is prepared to assist the Housing Committee to the utmost of its power.

The president (Mr. R. A. Savage), and secretary (Mr. W. J. Edmonds), are to be congratulated on their timely action, to which we wish all success.

Prize Competition.—We have received from the Association of Engineer-Electricians trained at the Institut Electrotechnique Montefiore, Liége, particulars of the international prize competition known as the Fondation George Montefiore. This is a triennial event, and the present competition is that which should have taken place in 1917, if circumstances had permitted of it; it will be decided in 1921. The subject is the best original work dealing with the scientific advance and progress in the technical applications of electricity in all domains. The jury consists of 10 engineer-electricians, five of whom are Belgian and five foreigners. The total amount of the prize money is 20,000 fr. The essays must be received not later than April 30th, 1921, by M. le Secrétaire-Archiviste de la Fondation George Montefiore, Rue Saint-Gilles, 31, Liége, Belgium, from whom particulars as to the conditions to be observed can be obtained. A few copies of these particulars are in our hands, and will be forwarded to applicants.

National Federation of Professional, &c., Workers.—The August issue of *Contact*, the journal of the National Association of Supervising Electricians, contains the draft constitution (as amended) of the National Federation of Professional, Technical, Administrative, and Supervising Workers. After stating the objects of the Federation, it gives particulars of the administrative organisation, annual fees, &c. A list of the Associations which have already joined the Federation is also given; it includes the N.A.S.E., the Association of Engineering and Shipbuilding Draughtsmen, the Electricity Supply Commercial Association, and nine other bodies.

Radium by the Gramme.—The day has passed when the milligramme was the only unit used for measuring quantities of radium salts. The world's available supplies are steadily mounting up. For example, the total radium production up to 1920 by the Standard Chemical Co. (Pittsburg, Pa.) is stated to amount to 50 grammes of radium element, with a present output at the rate of 18 grammes per year. The world's total available supply produced since the discovery of radium by Mme. Curie in 1898, is estimated at about 120 grammes. The company states that if the demand justifies it, it is prepared to produce 50 grammes of radium element yearly. Since 1913 three new radium factories have started in America, and several in France, the latter producing an average of 18 grammes of radium yearly during the war. Incidentally, practically all the British purchases of radium salts have been certified by the National Physical Laboratory, at which institution the British Radium Standard was deposited in 1913.

The Government bought a large quantity of radium during the war for use in gun-sights, dials of aircraft instruments, &c. The unused surplus from this has been lent by the Ministry of Health to the Middlesex Hospital for treatment purposes. The quantity of radium involved is nearly five grammes of the hydrated bromide, and it is being used at the Middlesex Hospital in experimental work connected with the treatment of cancer. Up to the present time it has been a matter for speculation whether the clinical results of exposing a malignant tumour to the rays from, say, a fifth of a gramme of radium for a certain number of hours would be improved if the density of the rays were increased 25 times, the time exposure being correspondingly reduced; the opportunity has now been provided for putting this important question to the test.

The possible danger to those concerned in handling such a quantity of radium as that in question has been carefully considered. When not in use, the radium is kept in a safe, inside which is a lead case weighing over a ton, the radium being placed in a cavity in the middle of the lead. The thickness of lead used ensures that not more than 1 part in 1,000,000 of the gamma rays emitted by the radium penetrates the safe. All manipulations are made without the operator's hands coming in contact with the radium receptacle.—*Journal of the Roentgen Society.*

"Safety First."—Thanks to the doctrine of "Safety First," the slogan of the Accident Prevention Movement, in the streets of London, between 1914 and 1918, traffic casualties were reduced by nearly 50 per cent. In factories and workshops accidents are diminishing, and results have been achieved beyond the most sanguine expectations. The small band of enthusiasts who set themselves to protect persons who needed protection against themselves is now justified by results.

At the Machine-Tool Trades Exhibition, to be held at Olympia next month, a great Convention will be held, under the joint auspices of the Home Office and the British Industrial "Safety First" Association. There will be two sessions, at which papers of absorbing interest will be discussed. Invitations to the Convention are being extended to the managements and workers of the principal industries throughout the country, to employers' federations, employés' organisations, Whitley Councils, the Federation of British Industries, and the National Union of Manufacturers; also to representatives of Government Departments and numerous other personages prominent in commercial and industrial circles. The arrangements for the Conference are in the hands of Mr. Gerald Bellhouse, C.B.E., the Deputy Chief Inspector of Factories and Workshops, and Mr. H. E. Blain, C.B.E., the well-known Operating Manager of the Underground Railway and London General Omnibus Group.

Visits to Electrical Works.—By courtesy of the Electricity Committee and the city electrical engineer (Mr. J. W. Hame), the members of the York Sub-Branch of the Association of Shipbuilding and Engineering Draughtsmen paid a visit of inspection, last week, to the Foss Islands electricity works of the York Corporation.

The members of the Leeds and Bradford Branches of the above-named Association, on August 19th, visited the Phœnix Works of the English Electric Co., Ltd., at Thornbury, Bradford, by invitation of the directors and Mr. P. J. Pybus.

Service Note.—It has been decided by the Admiralty to issue periodically papers on engineering subjects, and the first series is now about to be distributed. The object of this publication, says *The Times*, is to bring to the notice of engineer officers, from time to time, information not otherwise generally available to them, which is likely to prove of value and assistance in carrying out their official duties.

Film Publicity.—The need for making clear the path of the electrical contractor by educating the public up to the utility and methods of using electricity is a paramount one, and no better medium can be found than the kinematograph film. There are probably more patrons of the kinema than of the printed page, and in its report to the National Electric Light Association of the U.S.A., the Motion Picture Films Division Advertising and Publicity Service Bureau outlines the merits of this form of publicity, and suggests methods of employing motion pictures to the best advantage, at the same time recommending a further careful study of the possibilities involved. It is pointed out that thousands of pamphlets and other printed publications are daily swept away without receiving so much as a glance. At the best the average reader of such matter merely glances through it, perhaps noting points here and there without attaching a great deal of importance to them. On the other hand, the mental impression made by the visualisation of actual processes, &c., is much more lasting and influential. This is no doubt all very well if a sufficient number of proprietors of picture theatres can be induced to "screen" the matter provided by an Association utilising films for the purpose of combined advertisement and instruction. Payment will naturally be required in a great number of cases, based probably on the number of feet of film displayed. This raises the question of cost as compared with the cost of printed propaganda. This is a matter for investigation, as circumstances will differ to a great extent in various districts depending chiefly upon the attitude of the theatre owners. It is asked whether it is possible to establish such close relations with owners, directors, authors and others connected with the film producing industry that electrical appliances could be used in the ordinary film plays; this would constitute a much more subtle form of propaganda, and would do its work imperceptibly—probably a much better way of gaining the attention of the public. Finally, the possibilities of the small portable projecting set are touched upon, and there is no doubt that a wide field could be opened up by this means. Contractors in a large way of business could arrange for private displays on their premises or for use in lectures at local halls and institutions. If not overdone, as a great deal of publicity is nowadays, the use of the film should prove a great power for good from the electrical contractor's point of view.

Electricity and Oil Production.—In an article on the development of oil fields and the production of oil the *Journal of Electricity* describes the economies effected by the employment of electricity to supersede other forms of motive power. Oil producing companies which have made this change claim a much greater production by electrical methods. In the steam driven unit the steam pressure at the well will vary according to the temperature of the atmosphere, inasmuch as the steam lines from the boiler to the wells are never sufficiently lagged to ensure uniform temperature of the line. In addition to this the accumulation of water in the steam line causes at times a drop in pressure, and in each case a drop in pressure means a slowing down of the engine which in itself causes a reduction in production. The attendant when he makes his periodical rounds adjusts the speed of the equipment, but in the meantime the well has lost in production due to the lower speed at which it was operated.

This is not the case, however, with an electrically driven pump, inasmuch as the motor always operates at the predetermined speed until changed by an attendant. This ensures a uniform production.

The gas engine, due to engine troubles, has not the reliability of the motor. One operator who has replaced his gas engine by motors, claims that his production increased at least 20 per cent. due to the uniformity of drive.

The oil companies utilising electric motors say that they would under no consideration return to the other methods of drive. They prefer the motor for its reliability in service and the ease with which it can be handled.

The yearly load factor of the oil fields is very high at the sub-station, due to the fact that the load is continuous for 24 hours per day, 365 days in the year, the only interruption being when the well is cleaned. On a system where there is a large number of motors working it is hardly noticeable on the sub-station load chart when wells are being cleaned.

The power factor, however, of this load is very low. It varies in the different fields of the San Joaquin Light and Power Co. from 60 to 70 per cent. at the sub-station. This low power factor is due to the equipment used, and also to the character of load on the motor. The motors are mostly of the two-speed type or the low-speed star-delta type, both of which have a fairly low full load power factor. The motors are seldom loaded to full load for pumping duty. The load is pulsating in character varying with the stroke of the pump, this being smoothed out to some extent by counter balancing the pump rods at the motor end of the walking beam. These features account for the present low power factor of this load.

The average installation of motors is 10 H.P. for pumping and 30 H.P. for pulling the well. These are not separate motors, but one motor connected for 10 H.P. continuous duty as a pumping motor, or 30 H.P. intermittent duty as a pulling motor. The size of motor being used with standard tools in drilling, is at present 75 H.P. On a rotary installation, the company working in the Santa Maria fields used a 75-H.P. variable speed motor operating the rotary, and a 40-H.P. constant speed motor for operating the circulating pump.

It is stated that the cost of operating steam and gas plants is 50 and 60 per cent. respectively greater than the working cost of electrical plant.

Fuel Oil Burning Appliances.—In these days of expensive and inferior coal any notes on the employment of oil fuel in generating plants are of value. In an article published a short time ago the *Journal of Electricity* gave some interesting details of the various accessories required by the station employing oil fuel.

For power plants large cylindrical steel storage tanks are used. These are usually set on the ground outside the plant and are built in any desired size up to 50,000 barrels capacity. They are built up of riveted steel plates, the thickness of plate and strength of riveted joint being proportioned in accordance with the usual safety rules based on the internal pressure due to the head of oil inside the tank. Thus if the tank is 30 ft. high the internal pressure will be that due to 30 ft. head of oil or approximately 15 lb. per sq. in. It is customary to surround the storage tank by a concrete wall about 6 ft. high far enough away from the tank so that the entire contents of the tank will be held in by the wall in case of a leak in the tank.

Most power plants are provided with tanks of sufficient size to enable them to keep from ten to thirty days' supply of oil on hand. This storage capacity should preferably be divided among two or more tanks rather than all concentrated in a single tank, as this will enable one tank to be emptied for cleaning and repairs without shutting down the entire plant.

In some districts it is not permissible to locate the storage tanks above ground. The National Board of Fire Underwriters has adopted certain rules for the location of oil storage tanks. In general these rules provide that within the fire limits of cities the tank must be located so that its top is at least 3 ft. below the level of the fire room floor and below the lowest pipe in the building to be supplied. The tank must be set on a firm foundation, and covered with soft earth or sand, no air space being allowed immediately outside the tank.

Every oil storage tank must be provided with the following attachments: Filling pipe, suction pipe, vent pipe, smothering pipe, overflow pipe, and measuring rod or chain.

Oil is ordinarily measured by passing a rod or chain down through the top of the storage tank, the rod being marked off in feet, inches, and fractions of an inch. By sounding to the bottom of the tank, the depth of oil can be determined very accurately. A more convenient method, though not quite so accurate, is to use a float with a chain passing over a pulley at the top of the tank, the outer end having a pointer which indicates the height of oil in the tank on a suitably calibrated scale. The height of oil in the tank may also be determined by an indicating or recording pressure gauge, which depends for its operation on the hydrostatic pressure produced by the oil.

The oil is taken from the supply tank by the oil pump. The type of pump ordinarily used for this purpose is the ordinary duplex steam-driven reciprocating pump. The pump must have brass valves, and packing that will not be affected by the oil. The pump should be provided with a large air chamber to prevent pulsation of oil pressure due to the strokes of the pump. It is customary to install the pumps in duplicate so that one may be kept shut down at all times ready to go into service immediately if the other has to be shut down for repairs.

The oil pumps should be provided with a pump governor for the purpose of maintaining a steady oil pressure.

Every oil-burning plant must be provided with some form of strainer to remove the dirt and foreign matter which would be liable to remove dirt and foreign matter which would be liable to cause stoppage of the burners. The strainer may be placed either in the suction line between the supply tank and the pump or in the discharge line after leaving the pump, or both. The strainer usually consists of a perforated metal basket mounted in a suitable container, arranged so that the basket can be readily removed for cleaning.

In addition to the main strainer on the oil line, it is advisable to provide a small fine mesh strainer at each oil burner.

To clean this strainer it is only necessary to turn the handle on top so as to run the oil through the by-pass, place a bucket under the blow-out valve at the bottom and blow steam through by opening the small valve on the side.

Regulation of Hydro-Electric Units. — The *Electrical World* for August 7th contains some useful notes regarding the regulation of hydro-electric prime movers, by an American hydro-electrical engineer. There is a vast difference between the regulation of steam turbines and waterwheels, due principally to the smaller inertia of the latter, the nature of construction, and the medium of propulsion. A large flywheel effect is a helpful factor in speed control. The three main points to be borne in mind when considering speed-regulating devices are :—

(1) Ability to hold a constant, predetermined or normal speed at no load or at any constant unchanging load.

(2) Inherent regulation, usually expressed in terms of percentage of normal speed, and meaning the drop in speed from no-load to full-load conditions without manual adjustment. As a rule a prime mover can be arranged with a relay-type governor so as to have the same speed at full load as at no load without manual adjustment, but such a condition usually, and in the case of two prime movers operating alternators in parallel, would most certainly result in a condition of unstable equilibrium; so it is the usual practice to adjust all governors for an inherent regulation of from 2 to 3 per cent. Few regulate more closely and a great many not so closely.

(3) Momentary changes of speed due to changes of lead, occurring either gradually or suddenly, usually expressed in percentage of normal speed for a certain percentage of load change "on" or "off," and the time required, in seconds, for restoration of normal speed at the new load.

A modern well-designed and constructed hydro-electric installation may be and frequently is installed so that it will satisfy the first two points above quite as well as any steam-turbine installation; but to satisfy the third point as well is a practical impossibility and always will be, because the designer is confronted by unchanging natural laws.

Waterwheel governor design has settled down to one rather generally accepted type known as the "hydraulic relay compensated type," using a flyball governor, either belted or mechanically connected to the waterwheel shaft as a primary control and through a pilot valve, with restoring and compensating mechanism, and a relay valve controlling the flow of a fluid under pressure to one or more servo-motor cylinders that are suitably connected to and operate the speed gates through a combination of links and levers. The operating fluid has usually been a mineral oil, and in earlier designs each governor had its own individual pump, pressure tank and vacuum tank. The pump was continuously discharging oil into the pressure tank, which was partially filled with air to give elasticity and quick action, and the servo-motor cylinders discharged into the so-called vacuum tank, whence the oil was picked up as it came over by the pump. This was a closed system and was comparatively simple, but the oil was expensive, short-lived and gave off considerable carbon deposit.

In the last few years this system has been improved upon by substituting a discharge tank under atmospheric pressure for the vacuum tank and installing a pressure-operated unloading or by-pass device on the pump. In multiple installations a central pumping system has been installed, the pumps being motor-driven with automatic pressure-controlled starting and stopping devices. Both of these arrangements represent an improvement, and, owing to the relief of the oil, which is somewhat warm, from the vaporising effects of the low pressure in the vacuum tank, the oil appears to have a much longer life than previously and a reduced carbon deposit. In recent years and in larger installations it has become quite common practice to use water under pressure as the operating fluid, introducing 1.5 to 3 per cent. of soluble oil. The function of the oil is primarily to prevent corrosion of the working parts of the system with which it comes in contact. This has in most cases worked very well.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Buxton Corporation has increased the salaries of the borough electrical engineer and his chief assistant in accordance with the latest Civil Service scale, the increase to date from June 1st. MR. A. BISHOP'S salary is increased from £362 to £456, and MR. M. S. MASON'S from £260 to £343 per annum, including the fluctuating bonus.

MR. G. H. ROBERTS, M.P., has joined the Board of Messrs. Scholey & Co., Ltd., electrical and mechanical engineers, 56, Victoria Street, S.W.

Darwen Corporation Electricity Committee recommends that the salary of MR. FLETCHER, electrical engineer, be increased from £430 to £500 per annum.

MR. G. DOUGLAS COE, an assistant electrical engineer at the Blackburn Corporation electricity works, has been appointed borough electrical engineer of Wrexham, out of 129 applicants. He will commence his duties on October 1st.

Last week, at the Telephone Exchange, Crossley Street, Halifax, MR. SIMPSON, chief inspector in the engineering department, who is leaving Halifax for York, was presented by his colleagues with a silver keyless watch. Mr. Simpson is succeeded by Mr. Trickett, of Blackburn.

The *Manchester Guardian* stated that on August 19th MR. S. L. PEARCE, chief of the Manchester Electricity Department, and ALDERMAN DAGNALL, chairman of the Electricity Committee, were about to leave on a tour of the United States and Canada.

MR. ALEX. SPENCER has been elected a director of Vickers, Ltd., to fill the position recently vacated by MR. DUDLEY DOCKER. Mr. Spencer is a director of the Metropolitan Carriage, Wagon and Finance Co., Metropolitan-Vickers Electrical Co., Ltd.

MR. RALPHS, station superintendent at the Wrexham Corporation electricity works, who is leaving to take up an appointment at Bootle, has been presented by the staff with a case of silver-mounted pipes.

Hastings Corporation has increased the salary of the electrical engineer (MR. RUSSEL F. FERGUSON) from £600 to £964 (salary and bonus). The assistant electrical engineer has been given a basic salary of £250, which, with bonus, totals £420. The technical employés now receive an increase of 20 per cent. on the pre-war salary of the office, plus £120.

Obituary.—We learn with regret that MR. HENRY B. SAYERS, second son of Mr. Henry M. Sayers, M.I.E.E., died on August 23rd at his father's house in Streatham, in his 29th year. He has lately been on the staff of Alloy Welding Processes, Ltd., and collaborated with Major Caldwell in a paper on electric arc welding, presented to the I.E.E. last year.

NEW COMPANIES REGISTERED.

Jenner Light and Power Co., Ltd. (169,663).—Private company. Registered August 16th. Capital, £5,000 in £1 shares (4,000 preference). To take over the business of electrical engineers and contractors carried on at 11, Red Lion Square, W.C., as "H. Jenner & Co.," and to adopt an agreement with H. Jenner. The first directors are: H. Jenner, 35, Auckland Road, Ilford; C. G. Maisey, Warlingham, Jersey Road, Osterley Park; C. G. Wood, Bertwood, Wimbledon, S.W. Secretary: D. J. Gaillard. Registered office: 11, Red Lion Square, W.C.

Eric Rivers-Smith, Ltd. (169,658).—Private company. Registered August 16th. Capital, £1,000 in 800 ordinary shares of 10s. each and 600 deferred shares of £1 each. To carry on the business of electrical engineers and contractors, manufacturers of and dealers in fittings, accessories and appliances, &c. The subscribers (each with one deferred share) are: Mrs. E. Funnell, 25, High Street, Hampstead, N.W.3; J. H. Anneveld, 8, Albemarle Mansions, Holloway, N.7, accountant. The first directors are: R. Stagg and Eric Rivers-Smith. Solicitor: W. V. Reeve, 35, Coleman Street, E.C.

Zephyr Motor Transmission, Ltd. (169,702).—Private company. Registered August 17th. Capital, £75,000 in 10s. shares. To acquire improvements relating to the application and transmission of motor power to bicycles and other light road vehicles, lathes, drills and other power machinery; to adopt an agreement with the Rhodesian Enterprises, Ltd., and the Westminster Industrial Syndicate, Ltd. The subscribers (each with one share) are: W. A. Colyer, 329, High Holborn, W.C., solicitor; A. D. Vasey, St. Michael's Vicarage, New Southgate, N.11, clerk. The first directors are: Arnold J. Marks, Sir Buchanan Scott, K.C.I.E., W. A. Colyer and two others. Qualification, £100. Remuneration, £150 each per annum (chairman, £200) and 5 per cent. of the net profits divided. Registered office: 25, Victoria Street, Westminster.

E. J. Saunders & Co., Ltd. (169,712).—Private company. Registered August 18th. Capital, £2,000 in £1 shares. To take over the business of builders, painters, decorators, locksmiths, electricians, contractors, builders' merchants, &c., including goodwill and effects, but excluding book debts, carried on by E. J. Saunders, J. J. Saunders and H. J. Saunders at 79 and 81, Albany Street, St. Pancras, as "E. J. Saunders & Co." The first directors are: E. J. Saunders, 91, Belsize Lane, South Hampstead, N.W.; J. J. Saunders, 52, Dewsbury Road, Willesden, N.W. Secretary: H. J. Saunders. Registered office: 81, Albany Street, St. Pancras, N.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Steel Wing Co., Ltd. (formerly Krieger Electric Carriage Syndicate, Ltd.).—Mortgage dated August 6th, 1920, to secure advances up to £2,000, charged on certain money. Holder: D. J. Mooney, 48a, Gillingham Street, Westminster.

Gratze, Ltd. (old company).—Debenture dated July 28th, 1920, to secure £10,000 charged on company's undertaking and property, including uncalled capital. Holder: F. Clayton, 15, Hanover House, Regent's Park, N.W.

Cambridge Electric Supply Co., Ltd.—Particulars of £10,000 authorised March 10th, 1920, present £3,500 charged on company's undertaking and property, present and future.

W. A. and R. J. Jacobs, Ltd.—Debenture dated July 29th, 1920, to secure all sums, not exceeding £2,000, which the mortgagee may be called upon to pay under a guarantee to company's bankers, charged on company's property, present and future, including uncalled capital, but excluding certain leases. Holder: T. H. Dey, 93, Amhurst Park, N.

W. H. Rayner & Sons, Ltd.—Mortgage dated July 28th, 1920, to secure £1,000, charged on certain properties in Nottingham. Holders: Sir James W. McCraith, Kt., J.P., The Park, Nottingham, and others.

Allied Industries, Ltd. (in liquidation).—Satisfaction to the extent of £18,666 2s. 3d. on August 10th, 1920, of debentures dated October 17th, 1918, securing £33,000.

Brook Hirst & Co., Ltd. (95,264).—Return dated January 13th (filed July 7th, 1920). Capital, £20,000 in £1 shares. 12,500 shares taken up. £12,500 considered as paid. Mortgages and charges, £7,000.

Anglo-Portuguese Telephone, Ltd. (24,545).—Return dated July 19th, 1920. Capital, £500,000 in £1 shares. 460,000 shares taken up. £63,546 paid, being £1 per share on 51,046, and 1s. per share on 250,000. £98,954 considered as paid. Mortgages and charges, £79,015.

Orbit Electrical Co., Ltd.—S. Thompson, of 37, Lime Street, E.C., as receiver and manager on August 6th, 1920, under powers contained in debentures dated July 1st, 1919.

CITY NOTES.

The Swiss Brown, Boveri Co.

The report of Brown, Boveri et Compagnie of Baden, Switzerland, dealing with the year ended March 31st, 1920, refers to the issue of new shares for 12,000,000 fr. in September, 1919, a second issue of 7,000,000 fr. in connection with the conclusion of a community of interests with Vickers, Ltd., who received a participation to this amount, and a third issue of 1,000,000 fr., thus making a total increase of 20,000,000 fr., and bringing the share capital up to 56,000,000 fr. The gross profits amount to 15,137,000 fr., as compared with 11,811,000 fr. in 1918-19. After defraying general expenses, interest charges, &c., and making provision for depreciation, the accounts show net profits and balance forward of 5,084,000 fr., as contrasted with 4,104,000 fr. in 1918-19, and it is proposed to pay a dividend at the rate of 8 per cent., which will absorb 4,200,000 fr., as against 9 per cent. and 3,240,000 fr. respectively in the preceding year. Of the new shares, those representing 7,000,000 fr. participate in the dividend to the amount of one half, while on the remainder the full rate is payable.

The directors, referring to the course of business, state that the orders received at the end of 1918-19 and the beginning of the past financial year exhibited some weakness, but this situation of affairs was followed by a strong revival, and the total orders booked by the Swiss works reached 75,000,000 fr. in the year, of which about 30 per cent. applied to the inland market. As a result of the agreement with Vickers, Ltd., the company took up an interest in the Ateliers de Sécheron of Geneva, which was reorganised first by reducing the share capital from 10,000,000 fr. to 5,000,000 fr. and then increasing it to 10,000,000 fr. A participation was also taken up in the Micafil A.G. of Altstetten, makers of insulation materials, &c. The report proceeds to refer to other undertakings in which the company is interested, including the Scintilla A.G. of Solothurn, whose share capital was raised from 1,000,000 fr. to 3,000,000 fr. The Gleichrichter (Rectifier) A.G., of Glarus, was still burdened with the high costs of experiments and development, and had suffered losses through the fall in foreign exchange, but the company still had a wide scope for the future. The Audiffren Singrun Kalte Maschinen A.G. had removed its headquarters to Basle, and it could not be foreseen whether complications would result from the situation of manufacturing in the district of the Saar.

The report further mentions that the Elektrizitats Ges. Alioth, of Basle, made a distribution of 5 per cent. for 1919, as in the previous year, and the Motor A.G., of Baden, paid 5 per cent., as against 7 per cent. In the case of the Compagnie Electro-Mécanique, of Paris, the share capital was raised to 25,000,000 fr. in November, 1919, and a further advance to 40,000,000 fr. was made in the spring of 1920 so as to absorb the Société Francaise Westinghouse, in connection with the agreement with Vickers, Ltd., the French company having paid 8 per cent. for 1919 as in the preceding year. The Tecnomasio Italiano Brown-Boveri, of Milan, increased its share capital to 12,000,000 lire last year, upon which a dividend at the rate of 8 per cent. was paid, and a further capital expansion was impending in order to incorporate the Societa Italiana Westinghouse as a result of the agreement with Vickers, Ltd. The Brown-Boveri A.G., of Mannheim, raised its share capital from 9,000,000 to 15,000,000 marks, and subsequently to 40,000,000 marks, while loans for 24,000,000 marks were also issued. In addition the Isaria Zähler Werke A.G. (Meter Works), of Munich, doubled its share capital to 5,500,000 marks, and a minimum dividend of 15 per cent. for 1919-20 was expected, this being the same rate as in 1918-19. The A. S. Norsk Elektrisk & Brown, Boveri, of Christiania, again paid a dividend of 10 per cent., and the Austrian Brown, Boveri Werke, of Vienna, one of 7 per cent., while favourable results were also obtained by the subsidiary companies in Belgium, Holland and Spain. It is further stated that at the general meeting held in December, 1919, Sir Francis Barker, Sir Ernest Hiley and M. Guilleaume Pictet were elected to the board of directors in connection with the new arrangements previously mentioned.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

English Electric Co.—90,000 ordinary shares of £1 each, fully paid, Nos. 1,431,510 to 1,521,509.

India-Rubber, Gutta-Percha and Telegraph Works Co.—500,000 ordinary shares of £1 each, fully paid, Nos. 1 to 500,000; and 250,000 five per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 250,000.

The Committee has specially allowed dealings in the following under temporary regulation 4 (3):—

Oxford Electric Co.—£25,000 eight per cent. second mortgage debentures (regstered), Nos. 1 to 151 (£100); 1 to 184 (£50); and 1 to 35 (£20).

W. T. Henley's Telegraph Works Co., Ltd.—Dividend on the preference shares at the rate of 4½ per cent. per annum, less income tax, for the half year ended June 30th. Interim dividend on the ordinary shares of 1s. per share, less income tax.

Adelaide Electric Supply.—Dividend at rate of 6 per cent. per annum on 6 per cent. cumulative preference, less tax, for half-year ending August 31st.

Melbourne Electric Supply.—Dividend at rate of 7 per cent. per annum on 7 per cent. cumulative preference, less tax, for half-year ending August 31st.

Davis & Timmins.—Interim dividend of 3 per cent., free of tax, on the ordinary shares for the half-year.

Tyneside Electrical Development.—Interim dividend of 3 per cent. on preferred ordinary for past half-year.

Para Electric Railways and Lighting.—Dividend of 6 per cent. per annum, less tax, on ordinary and preference for half-year.

STOCKS AND SHARES.

Tuesday Evening.

There is a rather more cheerful tendency about Stock Exchange markets in the gilt-edged departments. Business remains retail, but in spite of the holiday season, the purely investment stocks show a good deal of strength, owing to the monetary outlook having taken a turn for the better. The threatened 8 per cent. Bank Rate is thought to be rather less of a certainty, and those called optimists are hopeful of the autumn stringency being circumvented without a rise in the Bank minimum. Industrial issues that depend upon coal conditions are mostly lower, in consequence of the outlook in the coal trade. There has been trouble in Sheffield, over the action of the Electrical Trades Union, and this served to depress the engineering shares generally.

Decided dulness developed amongst the various manufacturing shares. Crompton ordinary gave way to 18s. 6d. and changed hands as low as 17s. Edison Swans have been dealt in below a pound. Telegraph Constructions went back to 20. Henleys have dropped to 35s. General Electrics are exceptionally better at 27s. 6d. Telephone Manufacturing went back to 18s. 6d., and Siemens to 24s. 6d. English Electrics are 18s., and the 6 per cent. preference 15s., with the 5½ per cent. Sinking Fund debentures 82½.

British Electric Transformers have eased off to a guinea, and the 7 per cent. preference are 16s. 3d. Callender's new ordinary lately marked 25s. 6d.; the 7½ "B" preference drooped to 19s. 3d. Fuller's United Electric ordinary are dull at 15s. 9d., and the 8 per cent. participating preference can be bought for about 17s. 6d. The new 7 per cent. tax-free Short Term Notes stand at a trifle over 100.

The heaviness in the market for these various industrials is directly attributable to the Electrical Trades Union attitude, but this latter consideration simply serves to underline and emphasise the reasons set out in this column last week to explain the investor's reluctance to buy ordinary shares in most industrial companies. New issues continue to make their appearance—each offering more tempting terms than the last. While the public can get 7½ to 8½ per cent. on good-class preference shares—and 7 to 7½ per cent. on debentures—a round 10 per cent. is demanded from the ordinary shares. Nor does even this latter rate entirely satisfy those who argue that E.P.D. may lead to reduction in the dividends paid during the past few years. With the coal outlook so closely approximating the colour of the mineral, there is not much inducement to buy anything likely to be affected by a strike.

Home Railways, nevertheless, remain tolerably steady, and amongst Undergrounds, a rise of ½ restored Metropolitans to

20. The prospect of the various Tube lines starting to make profits under the fare-raising scheme is directing mild attention to Central Londons. Of the three classes of Guaranteed Assented stocks—ordinary, deferred ordinary and preferred ordinary—the first two stand about 42½, the preferred being 3 higher than the others. The ordinary stock, non-assented and non-guaranteed is 37½, the preferred 45½, and deferred 38½. For 1919 the last-named received 3 per cent. dividend. It is very doubtful, however, whether there is any appreciable amount of stock in the market at these prices. Indeed, the non-assented ordinary, although nominally 37½, changed hands at 42 towards the end of last week.

Cable stocks have begun to crumble a little in price, declines being shown by Eastern Extensions, Globe ordinary, Great Northerns and Cuba Submarines. Here, again, the influence of new issues operates as a factor of disturbance. The financial fashion of the moment is to offer securities upon which dividends will be paid free of tax, and these come, of course, into direct competition with the usually popular favourites amongst telegraph companies' stocks. Marconis soon lost their strength of a week ago, and are back to 56s. 3d. Direct United States gave way to 4¼. Foreigners make a poor showing. Mexican Light and Power common are supposed to be about 13, but a recent seller could get no better than 11 for the shares. Mexico Tramways sixes shed 3, and the news from the country is disappointing. Brazilian Tractions lost a trifle, and the Argentine market is dull. In the rubber share market a stiffening in the raw material is a hopeful feature, and helps to keep prices hard. Armaments are not bad, in spite of the coal trouble. Vickers notes are 3 premium, but Armstrong second debenture remains about 3 discount.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Aug. 24, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	62	—	£3 8 2
Charing Cross Ordinary	4	7	8½	—	10 15 6
do. do. do 4½ Pref.	4½	4½	9¾	—	8 3 8
Chelsea	3	4	9¾	—	8 0 0
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	— ¼	10 6 0
do do. 6 per cent. Pref.	6	6	8½	+ ½	7 3 0
Kensington Ordinary	6	7	8xd	—	9 0 6
London Electric	Nil	2½	11	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	22	— ¼	10 18 0
do. 4½ per cent. Pref.	4½	4½	9½	—	8 0 0
St. James' and Pall Mall	10	12	66	—	9 1 2
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79½	—	7 11 0
do. Def.	23/6	1½	17½	—	8 11 5
Chile Telephone	6	6	6	—	*5 0 0
Cuba Sub. Ord.	7	7	8	— ¼	*8 7 6
Eastern Extension	8	10	14½	— ½	*6 17 6
Eastern Tel. Ord.	8	10	14½	— ½	*6 14 4
Globe Tel. and T. Ord.	8	10	14½	— ½	*6 14 10
do. do. Pref.	6	6	8¾	—	7 1 2
Great Northern Tel.	22	22	21	— ½	10 4 8
Indo-European	18	10	30	—	6 6 8
Marconi	25	25	2½	— 1/8	8 8 0
Oriental Telephone Ord.	10	12	25	—	*4 16 0
United R. Plate Tel.	8	8	6¾	— ¼	*6 1 0
West India and Panama	1/3	Nil	½	—	Nil
Western Telegraph	8	10	15	—	*6 13 4
Home Rails.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	20xd	+ ½	6 5 0
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5.6	—	Nil
do. do. Income	5	4	87½	—	—
Foreign Trams, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5¼	8½	—	8 9 2
do. do. 2nd Pref.	Nil	Nil	8½	—	Nil
do. do. 5 Deb.	5	5	57½	—1	8 13 6
Brazil Tractions	Nil	Nil	47	— ½	Nil
Bombay Electric Pref.	6	6	122	—	4 10 0
British Columbia Elec. Rly. Pfcs.	5	5	54½	—	9 3 6
do. do. Preferrred	2½	5	43½	— ½	*7 2 6
do. do. Deferred	Nil	3	30xd	—	*6 19 0
do. do. Deb.	4½	4½	65	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	39	—	Nil
do. 6 per cent. Bonds	Nil	Nil	23	—3	Nil
Mexican Light Common	Nil	Nil	13	—1	Nil
do. Pref.	Nil	Nil	25½	—	Nil
do. 1st Bonds	Nil	Nil	60	—	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	3½	—	*3 0 0
British Aluminium Ord.	10	10	1	—	10 0 0
British Insulated Ord.	12½	15	13½	—	5 5 6
Callenders	25	15	1½	—	11 8 6
,, 6½ Pref.	6½	6½	18/-	—	7 4 5
Castner-Kellner	20	17	3	—	5 13 4
Crompton Ord.	10	10	18/6	—1/-	10 15 2
Edison-Swan, "A"	10	10	1½	— 1/8	9 8 6
do. do. 5 per cent. Deb.	5	5	76½	—	6 5 9
Electric Construction	10	10	½	—	10 13 4
Gen. Elec. Pref.	6¼	6¼	18/6	—	7 0 5
do. Ord.	10	10	1½	+ 1/8	*7 5 5
Henley	25	15	1½	— ⅛	8 11 5
do. 4½ Pref.	4½	4½	8½	—	6 13 6
India-Rubber	10	10	25/9	—	*7 15 4
Met.-Vickers Pref.	—	8	3½	—	7 6 2
Siemens Ord.	10	10	24/6	— 6d.	*8 3 6
Telegraph Con.	20	20	20	— ½	*6 0 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, August 24th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/5	..
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£50	...
a Copper Sulphate	,,	£42	£2 dec.
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/9	...
a Shellac	per cwt.	£34	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£26	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £945	...
c Brass (rolled metal 2" to 19" basis)	per lb.	1/4	½d. inc.
c ,, Tubes (solid drawn)	,,	1/8½ to 1/8½	...
c ,, Wire, basis	,,	1/8½	...
c Copper Tubes (solid drawn)	,,	1/9	...
g ,, Bars (best selected)	per ton	£166	...
g ,, Sheet	,,	£168	...
g ,, Rod	,,	£166	...
d ,, (Electrolytic) Bars	,,	£116	£1 dec.
d ,, ,, Sheets	,,	£158	£1 dec.
d ,, ,, Wire Rods	,,	£132	£1 dec.
d ,, ,, H.C. Wire	per lb.	1/0½	½d. dec.
f Ebonite Rod	,,	3/6	6d. inc.
f ,, Sheet	,,	3/-	6d. inc.
n German Silver Wire	,,	2/-	...
h Gutta-percha, fine	,,	14/-	...
h India-rubber, Para fine	,,	1/9½	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 6, P.O. qual.	,,	£59	...
g Lead, English Pig	,,	£36 10s.	30s. dec.
g Mercury	per bot.	£20 10s. to £21	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/6 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/3 to 2/6	...
d ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
r Silicium Bronze Wire	per lb.	1/11½	...
g Steel, Magnet, in bars	,,	1/8	...
n Tin, Block (English)	per ton	£262	£14 to £15 dec.
e ,, Wire, Nos. 1 to 16	per lb.	4/9	...
White Anti-friction Metals	per ton	£80 to £335	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespears.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Nela Research Laboratories, U.S.A.—Nela Research Laboratory was organised in 1908, under the directorship of Dr. Edward P. Hyde, as the Physical Laboratory of the National Electric Lamp Association; the name was changed to Nela Research Laboratory in 1913, when the National Electric Lamp Association became the National Lamp Works of the General Electric Co., U.S.A. For some years the Laboratory was devoted exclusively to the development of those sciences on which the art of lighting has its foundation, but in 1914 the functions of the Laboratory were extended by the addition of a small Section of Applied Science, which had an immediate practical objective. The Section of Applied Science is now being largely extended as a separate Laboratory of Applied Science under the immediate direction of Mr. M. Luckiesh, who becomes Director of Applied Science, and a new building is being constructed to house this branch of the work, which will be carried forward with a staff of several physicists, an engineer, an architect, and a designer, together with the necessary technical and clerical assistants.

Dr. Ernest Fox Nichols, formerly President of Dartmouth College, and more recently Professor of Physics at Yale University, as we recently stated, has accepted an invitation to assume the immediate direction of the Laboratory of Pure Science, under the title of Director of Pure Science. The work of this Laboratory will be continued in the present building, and somewhat further extended.

The Laboratory of Pure Science and the Laboratory of Applied Science will, together, constitute the Nela Research Laboratories, and will be co-ordinated under the general direction of Dr. Hyde, who becomes Director of Research.

This announcement illustrates three noteworthy tendencies of the present day, on which we have commented from time to time:—The importance attached to research in modern industrial concerns; the importance attached to research *in pure science*, as well as in applied science; and the migration of highly-trained scientific investigators from the Universities to the works—which will have very serious consequences for the former, unless means are found to retain their services as teachers by paying them adequate salaries.

ELECTRICAL CONDITIONS IN HOLLAND.

[A Government Official's Review of the Situation.]

The Department of Overseas Trade has issued a report on the "Economic, Financial, and Industrial Conditions of Holland" in 1919, prepared by Mr. R. V. Laming, O.B.E., commercial secretary to H.M. Legation, The Hague. The report and appendices extend to 114 pages, and a summary of those parts which will be of interest to our readers is given below.

The report, dealing with industry and production, states that the activity of the engineering works continued to improve, and orders for home account experienced an increase. It was possible to obtain coal and other raw materials more regularly, and the only competition that was feared was from German imports, but these were not popular owing to the deliveries and methods of payment being irregular, contract prices not being adhered to, and being liable to continual increases as the value of the mark declined. The future expectations were based upon the possibility of obtaining Dutch raw materials which would stabilise the costs of production and enable manufacturers to quote firm prices. In the case of the copper and metal foundries, the pre-war activity had been resumed by the end of the year, although raw materials and the cost of production were liable to fluctuations. The prospects were considered favourable for the most part.

The electrical industry was confronted with much competition from imports from Germany, namely, elements (batteries), &c. On the other hand, makers of electrical machinery did not experience any foreign rivalry. The production of electric lamp bulbs continued to increase owing to the large demand and the excellent quality of the output, this branch not being influenced by the adverse exchanges. Makers of enamelled ironware were faced with competition from abroad, but were able generally to maintain their position in the home markets. The copper rolling mills in general found an improved demand, but the reduction in working hours was felt to be a handicap. The gas works benefited by the improved conditions after rationing of the supply was discontinued, and the fuel deliveries were more regular and of better quality. It is noted that the effects of rationing have been maintained, economisers being generally in use, and petroleum also being more widely employed, both for cooking and heating purposes. In this connection it is mentioned that while electricity was generally being utilised for lighting purposes as much as possible, for reasons of economy, the consumption of gas generally declined, as compared with the conditions before the war. Not only so, but the development of the distribution of electric power in many districts rendered it possible to extend the milling of flour in these areas.

The general conclusion is that the Dutch industries were able to resume activity sooner than was expected after the long period of stagnation due to war conditions.

Radio-Telegraphy.

The report quotes from a commercial journal an article by Prof. C. L. van der Bilt, of Delft University, dealing with the development of wireless telegraphy. It is first mentioned that the Government station erected at Scheveningen in 1904 now works within a radius of 500 miles, and the wireless installations on Dutch ships, which were controlled by the Société Internationale de Telegraphie Sans Fil, were taken over by the Dutch Telegraph Co., "Radio-Holland," last September.

The question of establishing direct communication between the Netherlands and the East Indian colonies has now been practically solved. After various experiments, the Dutch Government commenced the construction of two powerful stations at Kootwijk, near Apeldoorn, Gelderland, and at Sambeek, near Boxmeer, North Brabant. It was decided to erect a transmitting station with a high frequency machine and frequency duplicators on the Telefunken system, with a separate receiving station. A preliminary credit of 5,000,000 fl. was voted by the States General, and in September, 1918, a contract was concluded with the Gesellschaft für Drahtlose Telegraphie for the supply of separate transmitting and receiving stations for direct communication with the East Indies, and, if desired, with other countries. The stations are so planned that a duplex service is said to be possible.

The receiving station at Sambeek was begun in August, 1919; the antennæ will be in harmony with the transmitting station situated on the plateau of Bandoeng, Java; and the station is equipped for receiving damped and undamped waves up to a wave length of 40,000 metres. On the other hand, the transmitting station at Kootwijk contains a high frequency alternating-current generator of 500 kw. at 6,000 periods, together with frequency transformers. By the use of various combinations it will be possible to generate waves of 6,000 to 12,000 metres and more in length. Trial messages from Java have been frequently heard at Huizen and Blaricum, North Holland.

It is also mentioned that a powerful station has recently been constructed at Curacoa, and plans exist for the erection of another station at Surinam, so that the Netherlands West Indies will also be able to participate in wireless communication all over the world.

Electrification of Railways and Tramways.

Coming to consider the subject of the electrification of railways and tramways, the report states that the conversion of the railway between The Hague and Amsterdam and Amersfoort is projected, and many of the steam tramway companies are contemplating similar action. The railway companies have sent a commission abroad to inquire and report on the systems of electric traction in use in England, Switzerland, and America, and on the completion of the tour, a decision will be reached as to the most advantageous method for use in Holland. Although no railways were converted during the war, there was a tendency in the public administration towards the general electrification of all power schemes, mines, large industrial undertakings, &c.

State-controlled Electricity Supply.

The Minister of Public Works appointed a commission in April, 1919, to report on a scheme for the supply of electric power under one uniform control. In the course of its report the Commission expresses the opinion that the production of electric power as a whole should be entrusted to the State, power being supplied in bulk through high-tension feeders from central stations to transformer stations; that the work of transmitting energy from the distributing centres to the principal places of consumption should be allotted to the provincial governments, and that the direct supply to consumers ought to be placed in the hands of the municipal councils. It is, however, recommended that the provincial governments should be empowered to furnish energy independently of municipalities to undertakings of more than a local character, such as tramways, works for the draining of marshes, large factories, &c., and that certain towns already having generating stations should be exempt from these proposals.

The execution of the scheme would require the erection of a high-tension overhead network for a minimum pressure of 50,000 volts, fed from a number of generating stations, whilst the energy would be distributed at 10,000 volts through the transformer stations. It is mentioned that generation in the long run will be effected most economically from a small number of stations, each of a capacity of 75,000 kw., that the cost of several stations of from 200,000 to 300,000 kw. would amount to 50,000,000 fl., and a network of mains and transformer stations for these powers would represent a further 75,000,000 fl., extended over a period of from 5 to 10 years. The Commission makes suggestions for initial works, proposes the formation of a joint stock company to undertake the work, in which the shareholders are the State, the provincial governments, and the municipalities, and suggests the constitution of an Electricity Council of at least 15 members to control the industry, and the appropriation by Bill of 10,000,000 fl. for the State electrical industry in 1920.

The appendices contain a report from the Acting British Consul at Amsterdam, who states that there is a general tendency to combine the electrification of large parts of the province. Thus a new company was formed under the title of the P.E.G.E.M., which is really a combination of the electrical works of Amsterdam, Haarlem, and Alkmaar. A project is on hand to electrify the whole of the Watergraafmeer "polder" (drained marsh) at a cost of 2,000,000 fl., and it is also proposed to convert to electric traction the existing steam railway between Amsterdam and Hilversum, and Amsterdam and The Hague. A further appendix gives the following figures concerning the Dutch exports of electric glow lamps in 1919:—

Exports of Glow Lamps in 1919.

Destination.	Weight in metrical tons.	Value in florins.
France	595.93	5,468,304
Great Britain	289.05	2,993,816
Belgium	264.14	2,338,939
Italy	299.99	2,330,397
Sweden	177.44	1,435,660
Argentina	128.22	1,196,870
Spain	114.01	920,196
Brazil	87.72	835,906
Denmark	98.18	796,721
Australia and New Zealand	97.95	799,191
Total, including all destinations ...	2,745.06	23,561,258

German Price Reduction.—The sale price department of the Union of the German Electrical Industry, despite increase in wages, salaries, and general expenses, has reduced the war-time additions on machines and transformers by 10 per cent., in the price determination of which the prices of iron and steel play an important part. In the case of other manufactures, however, it has not been possible to lower prices, as the costs of production are mainly based upon wages, salaries and general expenses, or upon the cost of raw materials such as porcelain, marble, insulating material, zinc castings, &c., the prices of which have not yet fallen.

EXTRA LONG-DISTANCE TRANSMISSION OF ELECTRICAL ENERGY.

Principles and Applications of the Quarter-Wave and Half-Wave Systems.

(*Continued from page 251*).

The Half-wave Transmission Line.—In the earlier portions of this article we have considered, with numerical data, the transmission of high power—in the neighbourhood of 100,000 KW.—over distances such as 300 miles, using the constant voltage system of transmission now employed almost universally. It has also been shown that the quarter-wave system makes possible, in certain cases, economical transmission over greater distances and under better conditions, particularly with regard to regulation. This was demonstrated by aid of a numerical example for transmission over a distance of 750 miles.

It is now proposed to show, again by the aid of a numerical example, that under certain conditions yet better results can be obtained over even greater distances and *without using any other generating-station equipment than that which is already well known and proven in industrial service.* To this end we employ the "half-wave line," and, for the present, we will assume that it is desired to transmit energy in bulk from point to point without intermediate tappings.

In the quarter-wave system the line is such that the time required for electrical propagation from end to end is *one-quarter* of the periodic time of the alternating current employed. The relation between frequency, velocity, and length of time is then: $f = v/4l$. In the half-wave system the line is such that the time of propagation is *one-half* of the periodic time of the current. Then $f = v/2l$, corresponding to a line length of 1,880 miles (3,000 km.) in the case of 50-cycle working. Also $f = 1/2l\sqrt{(L_1 C_1)}$, where L_1 C_1 represent the inductance and capacity per unit length.

Fundamental Equations.—Assuming that the delivery end of the line is connected to a circuit absorbing a current I_0 at voltage U_0, the current I and voltage U required at each point in the line, to yield I_0 and U_0 at the load, are given by:—

$$I = I_0 \cos \beta l - j U_0 \sqrt{(C_1/L_1)} \times \sin \beta l$$

and $U = U_0 \cos \beta l - j I_0 \sqrt{(L_1/C_1)} \times \sin \beta l$, the line resistance being neglected for the first approximation. The angle βl, called the angle of phase distance, is such that for a half-wave line, $\beta l = \pi$; β being a constant. Substituting $\cos \beta l = -1$, and $\sin \beta l = 0$, we have for a half-wave line $I = -I_0$, and $U = -U_0$. The corresponding result for a quarter-wave line, or for the centre point of a half-wave line, is: $I_2 = -j U_0 \sqrt{(C_1/L_1)}$, and $U_2 = -j I_0 \sqrt{(L_1/C_1)}$.

From these equations it will be seen that the half-wave line is suitable for the transmission of energy at constant voltage, and that it justifies the hope that exceptionally favourable results will be obtained, for—neglecting simply the resistance—we find that the self-induction and capacity of the line vanish from our equations, and so do the resistance and power factor of the load. The capacity current which is often so troublesome and, in lines of moderate length, more troublesome the greater the distance, here disappears. When $I_0 = 0$, $I = 0$ as well. In other words, the alternators have not to supply any current when the line is on open circuit. The centre of the line is nevertheless traversed by an appreciable current under these conditions, and it is this current which remains constant when the load varies (as already discussed in connection with quarter-wave transmission). Thus, on open circuit $I_0 = 0$ and I_2 has the value given above, and may be regarded as made up of two component currents flowing in opposite directions from the centre of the line, and becoming zero at each end. We have thus a form of resonance, a current flowing in the central portions of the line, but no demand being made upon the alternator.

In the preceding paragraphs it has, of course, been assumed that the line resistance is zero, and in order to ascertain the influence of line resistance and to study quantitatively the characteristics of half-wave lines, we may take a numerical example.

Numerical Example of Half-Wave Transmission.—In order to facilitate comparisons, the line considered is assumed to be identical with the quarter-wave line already studied, except that it is about twice as long, viz., 2,370 km. (1,485 miles), instead of 1,200 km. (750 miles). Aluminium cables of 5 sq. cm. section are assumed, and the cases considered are transmission of 100,000 KW., 75,000 KW., and 50,000 KW. with power factors 1·0, 0·9, 0·8, and 0·7. The phase of the delivered voltage is taken as zero, and it is assumed that the delivered phase-voltage is 100,000 volts, *i.e.*, 173,000 volts between lines.

Table V shows the conditions obtaining in the several cases considered. It is found that:—(1) To obtain 100,000 volts delivered phase-voltage, it is sufficient to maintain at the beginning of the line a pressure rising from 102,500 volts on open circuit to 131,000 volts on full load. The ratio of these initial voltages is only 1 : 1·28, and the actual value of the initial voltage is practically independent of the power factor of the load. If automatic voltage regulators be used to control the input voltage according to the law:—

U = (101,500 + 7,000 volts per 40,000 KW. input), the delivered voltage will remain 100,000 volts constant within 1 per cent. The regulation could probably be rendered yet better by taking into account power-factor, since the power-factors at the two ends of the line vary together.

2. Three aluminium conductors, each of 5 sq. cm., can thus transmit 100,000 KW., with a station voltage not exceeding 131,000 volts between line and neutral, or 225,000 volts between phases. The weight of the conductors would be about 100 kg. (220 lb.) per KW. transmitted, so that their cost would certainly be no obstacle to the use of the system.

3. The efficiency, above 50,000 or 60,000 KW., is about 60 per cent. for all power factors within the range considered. Higher efficiency could be obtained, without undue capital expenditure, by using larger conductors.

4. The light-load current is practically nil, and the current then delivered by the machines is at unity power factor.

5. The delivered voltage is displaced in phase by 180° to 193 from the input voltage, and the delivered current is displaced 171° to 179° from the input current, *i.e.*, in both cases the phase displacement is about 180°. The power factor is, therefore, practically the same at both ends of the line, such difference as exists being in a favourable direction, *i.e.*, higher power factor at the station end of the line.

TABLE V.—Load Characteristics of Half-Wave Line, 1,485 Miles (2,370 km.) in Length.

Power delivered at 102,000 volts phase-voltage in KW.	Load.		Input.				Efficiency, %
	Power factor	Current amps.	Phase voltage.	Current amps.	Power factor.	Power, KW.	
100,000	1·0	333·3	130,400	399·2	0·9998	156,000	64·0
	0·9	371	130,500	430·6	0·965	162,900	61·4
	0·8	416	130,900	470·2	0·925	170,800	58·5
	0·7	476	131,900	527·2	0·886	184,400	54·2
75,000	1·0	250	123,400	314·2	0·9998	116,500	64·5
	0·9	278	123,200	339·3	0·963	120,800	62·1
	0·8	312	123,500	369·7	0·914	125,000	60·0
	0·7	357	123,900	410·3	0·871	133,700	56·2
50,000	1·0	166·7	116,500	228·7	0·9997	79,700	62·8
	0·9	185·5	116,200	241·7	0·966	81,300	61·5
	0·8	208	116,200	259·5	0·922	83,400	60·0
	0·7	238	116,400	284·3	0·872	86,600	57·8
Open circuit	—	—	102,500	58·3	0·998	17,950	—

Small variations in frequency have no serious effect, the line remaining a half-wave line to the same extent that its half remains a quarter-wave line. Nevertheless, it is of course, desirable that the frequency should be as nearly as possible constant.

Over-Voltages.—The general magnitude of over-voltage attained may be determined by neglecting the line resistance as a first approximation. On the basis of calculations which it is unnecessary to reproduce, M. Bunet concludes that:—(1) At the middle of the half-wave line the load current of 476 amperes (corresponding to 100,000 KW. at 0·7 power factor) would produce a phase pressure of 175,000 volts, or 300,000 volts between phases; (2) maximum over-voltage would be reached at about 75 per cent. of the distance alone the line (*i.e.*, at the quarter point near the load), and would there be about 180,000 volts, or more than 300,000 volts between phases when the load current = 476 amperes at $\cos \varphi = 0{\cdot}7$.

Obviously, line pressures in the neighbourhood of 300,000 volts constitute a practical objection to the system, but this actual value applies to the hypothetical example here considered, and it is to be hoped that by the time it becomes necessary to transmit electricity 1,500 miles, the safe limit of voltage will also have been increased.

When the half-wave line is on open circuit, the voltage—equal at the ends—decreases to about 0·7 times the initial value at the quarter-points, and almost to zero at the mid-point. As viewed from the axis of distance, the voltage curve is then very convex. On increasing the load, the voltage curve becomes less convex, and assumes successively the form of a lower and upper lip; ultimately the over-voltages appear. For given power, the voltage curve is less convex, or more concave, in general form, the lower the power factor. The curve rises less rapidly when the inductance diminishes or when the capacity increases, since L/C is the coefficient determining the progressive displacement of the curve with load.

The effect of increasing capacity (by the use of insulated cables) is considered later, but, without having recourse to this expedient, the natural coefficients for overhead lines allow 50,000 KW. to be transmitted by a three-phase line without serious over-voltages, even if the power factor falls to 0·7 (the actual phase voltages being then about 90,000 volts at the mid-point and 124,000 volts at the quarter-points. With a higher power factor, 75,000 KW. could be transmitted, and even 100,000 KW. could be transmitted without exceeding 225,000 volts between phases if the power factor be near unity. Even if it be necessary to limit the power to 50,000 KW., the cost of conductors is not prohibitive.

Since L_1 and C_1 do not vary much with reduction in the size of wire, over-voltages might be eliminated by using smaller conductors conveying less power. Three conductors each of 1 sq. cm. section would transmit safely much more than one-fifth of the power transmitted by lines of 5 sq. cm. section, but the efficiency would be low, because the current at the centre would remain about 275 amperes (corresponding to quarter-wave constant-current conditions) whatever the power absorbed.

Protection against excessive voltage resulting from excessive current would be obtained by overload circuit-breakers; and lightning arresters would be installed along the line and adjusted for a pressure lower than the puncture-voltage of the insulators.

Comparison with 500-km. Transmission.—Table VI makes possible comparison between the performance of a half-wave line and that of an ordinary three-phase line using aluminium cables of

500 sq. mm. section or copper cables of 300 sq. mm. The maximum power transmitted is taken to be 75,000 KW. at power factors of from 1·0 to 0·7, and with 173,000 volts between phases at the load. The suffix a after the power factor at the station indicates that the current leads on the voltage; similarly, r indicates that the current lags.

TABLE VI.—LOAD CHARACTERISTICS OF ORDINARY THREE-PHASE LINE, 312 MILES (500 KM) IN LENGTH.

Power delivered at 100,000 volts phase-voltage in KW.	Load.		Input.				—
	Power factor.	Current amps.	Phase voltage.	Current amps.	Power factor.	Power, KW.	Efficiency. %
75,000	1·0	240	105,600	259	0·995 a	81,500	92·0
	0·9	278	126,500	212	0·995 r	80,300	93·5
	0·8	312	141,100	202	0·958 r	81,900	91·6
	0·7	357	154,800	205	0·876 r	83,400	90·0
37,500	1·0	125	88,600	192	0·780 a	39,900	94·0
	0·9	139	101 200	154	0 840 a	39 500	95·0
	0·8	156	107,200	136	0·891 a	39,100	96·0
	0 7	178	115,500	120	0·945 a	39,200	95·7
Open circuit	—	—	79,300	163	0·045 a	600	—

The principal facts disclosed by the table are as follows:—(1) To maintain 100,000 volts phase-voltage at the load, the input voltage must be varied from 79,300 volts on open circuit to 154,800 volts when supplying 75,000 KW. at 0·7 power factor, *i.e.*, in the ratio 1 : 1·95.

From the point of view of maximum line voltage the ordinary transmission line for 500 km. is practically equivalent to the half-wave line for 2,400 km. This is only what might be expected; the maximum pressure in a half-wave system is near the quarter-points (of its length), and is there about equal to the voltage which would have to be provided for ordinary transmission over this quarter distance.

In the 500-km. transmission the input voltage for given delivered power varies considerably with the power factor (the ratio being 1 : 1·46 for cos ϕ varying from 1·0 to 0·7 with 75,000 KW., and 1 : 1·29 for the same variations with 37,500 KW.). It is, therefore, impossible in this case to vary the input voltage according to a simple law so as to maintain constant voltage at the load.

2. The three aluminium lines, each of 5 sq. cm., transmit 50,000 KW. without exceeding 130,000-volts phase voltage (225,000 volts between lines) at the station. This corresponds to 42 kg. per KW., which is economical as regards line cost, but the regulation is bad.

3. The efficiency is good, viz., about 95 per cent. over a wide range of load and power factor, and the section of the conductors might be reduced without serious inconvenience.

4. The capacity current is about three-fourths of the maximum delivered current. The power factor on open circuit is very low, and the alternators are then difficult to operate in parallel.

5. The power factor is very different at the two ends of the line, the current being considerably more in advance at the station end.

On the whole, the comparison is more favourable to the 2,400-km. transmission than to the 500-km. line. The half-wave line would eliminate the bad regulation experienced in certain large networks now in service. In some of the latter it has been necessary to install very large over-excited synchronous motors in order to modify the power factor and keep the voltage reasonably constant at the load. For instance, the Southern California Edison Co. has installed at Los Angeles, at the end of a 250-mile (400-km.) line operating at 150,000 volts, 60 cycles, two 15,000-K.V.A. synchronous motors running light. Even these are unable to maintain good regulation, and a third unit of 30,000 K.V.A. is being installed. About 3,000 KW. will be dissipated as heat in order to maintain steady voltage. This is a serious factor, but the use of synchronous motors in such a case is preferable to taking the current several times the distance in order to make the line a half-wave system. The possibility of other arrangements is considered later.

Combined Half-Wave and Quarter-Wave Transmission.—Since the voltage along a half-wave system varies in a manner which itself changes with the power transmitted, the half-wave system is inherently restricted to the transmission of energy *en bloc* from end to end of the line. At the centre of the line there is, however, practically constant current as in the quarter-wave system. With 100,000 volts constant phase-voltage at the load, the current half way along the half-wave system varies only within the limits: $I_2 = 265 + 7$ amperes per 18 000 KW. in the case already considered, the voltage varying from $U_2 = 11{,}300$ volts, when the load circuit is open, to 126,500 volts when the load is 75,000 KW. at cos $\phi = 0·8$.

It is possible, under certain conditions, to draw energy from, or near, the centre of the line. If a variable resistance a be connected in each conductor at this point, it is necessary to maintain at the station a voltage U' instead of U, as though the load current were I_0' instead of I_0. This does not, however, change the voltage regulation at the station; the current is simply increased in the ratio $I_0' : I_0$. The resistance may be inductive. In either case, if the load at the centre is small compared with the total power, the system is practicable.

The end of a more or less inductive resistance, one or several transformers may be connected in series in the line (at or near the centre point), the secondaries serving constant current circuits. Alternatively, the central load may take the form of motors or converter groups. The motors would have to be alternators, with series characteristics, running at a constant speed when traversed by constant current, the terminal voltage increasing with the load.

Allowing for the resistance of the line, the current is not quite constant. In the example already considered, it was 265 amperes on open circuit, 280 amperes when delivering 37,500 KW., and 295 amperes when delivering 75,000 KW., or, say, an average of 280 amperes ± 5 per cent. Similarly, there would be certain variations in delivered voltage with variations in the intermediate series load.

Such an arrangement might consist in constant-voltage transmission from Niagara to New Orleans with a constant current tapping at St. Louis; or from the Zambesi Falls to the Cape, with a tapping at Pretoria; or from Montenegro and Dalmatia to Petrograd, with a tapping to serve the industrial district of Poland; or the same transmission to Paris with a detour through Berlin. These examples are offered simply to illustrate the distances involved by half-wave transmission at 50 cycles per second. At lower frequencies the distance would, of course, be increased, whilst at 125 cycles per second (which has been exceeded in lighting circuits) the distance would be about 625 miles for half-wave and 315 miles for quarter-wave transmission.

Underground Cables.—Hitherto underground cables have not been made for such high pressures as those considered in the above examples. Perhaps such cables could be built up *in situ* by placing unarmoured cables in cast-iron pipes and filling the latter with insulating compound after preliminary evacuation; the cost of such a cable might be no higher than that of armoured cables such as have been used, or proposed, for D.C. series systems. Whatever may prove to be the voltage limit of underground cables, it is worth while to investigate briefly the principal characteristics of quarter-wave and half-wave transmission using underground cables.

The velocity of propagation is reduced from v to $v/\sqrt{(\mu K)}$ in a medium of permeability μ and specific inductive capacity K. With $\mu = 1$ and $K = 3$ the speed of propagation is reduced by the factor $1/\sqrt{3}$, and the quarter-wave and half-wave distances are reduced by the same factor. Under these conditions the half-wave distance at 50 cycles per second becomes a little less than 1,060 miles (1,700 km.). The transmission would have the same general characteristics as in the case of overhead conductors with the very important advantage that, owing to the increase in capacity and reduction in self-inductance (compared with overhead lines), over-voltages would be eliminated. The characteristics of the E.H.T. cable required can only be estimated approximately, but when delivering 100,000 KW., the voltage at the centre of a half-wave system would be about 26,000 volts, and at the quarter-points 84,000 volts (compared with 180,000 volts at the quarter-points of an overhead line). In other words, the maximum voltage along the cable would be lower than the voltage at the ends.

This, however, involves a corresponding increase in the current. If the pressure be 25 per cent. of the terminal value at certain points in the line, the current becomes simultaneously four times as great, with a corresponding increase in losses and heating.

A combination of overhead and underground lines might combine the advantages and eliminate the disadvantages of the individual systems. In addition, such a mixed installation might conform very well to the practical requirement that extra high-tension lines be carried underground in closely populated areas. Clearly there is room for further study concerning the best distribution of self-inductance and capacity in lines of different lengths, and the benefits to be gained by modifying these factors.

(To be continued.)

ALTERNATING CURRENT TRACK-CIRCUITING.

By L. H. PETER, A.M.I.E.E.

(*Abstract of paper published in the Journal of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page 254.*)

In cases where A.C. track circuits are installed on electrified roads using the running rails for the propulsion return current, it is essential that the A.C. apparatus should not be affected by D.C. Where single-rail track circuits are installed, the return traction current has two paths back to the power station. One lies on the continuous return rail, and a parallel path is formed through the relay track-winding and back on to the continuous return rail. The resistance of this alternative path must be kept sufficiently high in relation to that of the continuous return rail to limit the D.C. passing through the relay and transformer secondary windings to a value which will not affect the operation of the relay or transformer by saturation.

This protection may also be obtained by placing small impedance coils across the transformer secondary and across the relay, these coils having relatively large impedance, but low ohmic resistance.

The impedance of a bond is to some extent dependent on the track voltage at which it is worked, the rise in impedance with the track voltage being greater with small air-gaps. Variation in impedance due to D.C. unbalancing of the bond is greater with the non-resonated than with the resonated type.

The impedance curves of a bond having a capacity of 750 amperes (D.C.) per rail are shown in fig. 8. The tests were

made at 50 cycles. With the 0.06in. air-gap the impedance only rises slightly over a wide range of track voltage. The same bond was used to obtain fig. 9, a condenser coil now being connected up and the number of turns in circuit in the coil being adjusted to give the bond as nearly as possible unity power factor. In both figures it has been assumed that the D.C. propulsion return current in the two rails is equal. This is not always the case, and the bond impedance varies as the D.C. unbalancing current changes. If the bond is situated at a point on the line where there is always a certain amount of unbalancing current present, the drop in impedance can be overcome by altering the tapping of the condenser coil, thus giving the bond a leading power factor when no unbalancing exists, and the power factor then becoming unity when the pre-determined unbalancing current is present. The variation in impedance of the bond is less at lower frequencies, and at 25 cycles it is possible to build a resonated bond having less than 10 per cent. variation in impedance between 0 and 200 amperes (D.C.) unbalancing current over a range of track voltages of from 0.25 to 6 volts.

This variation in impedance, which appears to grow as the frequency of the signalling current supply is increased, would appear to be due to the increase in the watt loss in the laminated core of the bond. It is not advisable to reduce the volume of the iron in the bond core. The normal working flux-density of these bonds is in the neighbourhood of from 500 to 600 lines per sq. in. It is only by working at low densities that the bond losses on the A.C. side can be kept small. The keeping of these losses low is of great importance, particularly in the resonated bond.

The necessity for using a large quantity of iron in the bond only applies in the case of D.C. electrified roads where the heavy return traction current necessitates the bond having an air-gap to avoid saturation.

Reference has been made to the utilisation of the resonated bond. This consists in varying the number of turns in circuit in the condenser coil of the bond until a tapping is found which gives the desired result on the relay. This variation of the condenser circuit varies the bond power-factor, and in some cases is futile, and although the phase angle at the relay may be improved, the impedance of the bond may be decreased sufficiently to nullify the advantage of this improvement. If, however, it is found possible to vary the

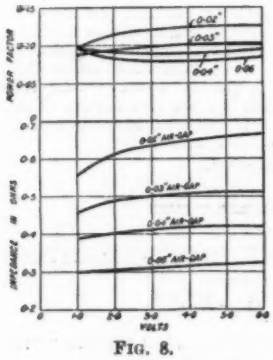


Fig. 8.

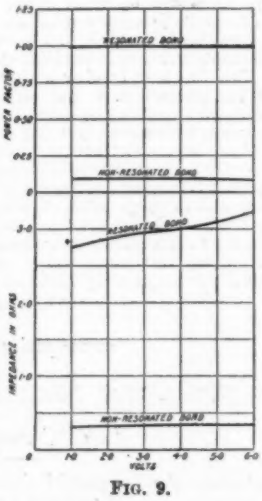


Fig. 9.

Fig. 8.—Impedance and P.F. of Resonated Bond with Various Air Gaps.

Fig. 9.—Impedance and P.F. of Resonated and Non-resonated Bonds.

condenser in such a way that both the voltage across the relay track winding and the phase angle between the relay local and track currents are improved, then the adjustment is a good one, and improved shunting of the track and possibly a reduction in the track feed current will result. To obtain the best results from any double-rail track circuit with impedance bonds, it is necessary to make these adjustments when the track circuit is installed, and as nearly as possible under the normal working conditions of ballast resistance and unbalancing current, both the voltage across the relay and the phase angle being checked while the adjustment is being made.

We may now consider the effect of direct current on the relay. Relays of the galvanometer, vane, or induction-motor type are all immune from operation by D.C., and the only effects on them are those which will cause the relay to drop—a "safe" failure, but one which must be guarded against to prevent traffic delays. If the relay is of the "in phase" galvanometer type containing no iron, the D.C. effect is not marked and only adversely affects the relay as far as heating is concerned. Excess of D.C. through the relay track winding may damage flexible connections to the moving armature, but otherwise this relay may be considered to be non-affected by D.C. The "quadrature" relays contain iron in some part or another, and, if used for single-rail track circuits, must be protected against saturation by D.C. passing through the parallel path mentioned above. In practice the relay is protected in a similar way to the track transformer by keeping the resistance up as much as possible, and it may also have an air-gap in its iron circuit which will assist in this protection; D.C. has the same effect on this type of relay as on the impedance bond, that is, it decreases the impedance.

No mention has so far been made of the relays adopted for track-circuiting roads on which A.C. traction current is returned to the power house through both running rails. In such cases it is customary to adopt a higher frequency for the signalling current and to use a relay which is definitely selective, and is, therefore, not operated by the lower-frequency traction current. Such relays, if of the two-element type, come under the same classification as that applied to all other two-element relays, namely, "in phase" or "quadrature," and are treated in the same way when constructing the track-circuit vector diagrams.

REVIEWS.

Electric Welding and Welding Appliances. By Herbert Carmael, A.M.I.C.E., A.M.I.E.E. Pp. 128; 84 drawings and other illustrations. London: Constable & Co., Ltd., 1920. Price 18s. net.

This book, the preface states, is an almost *verbatim* reprint of articles which appeared in *The Engineer* during some months of 1919. The character of the book is well defined by that fact, it gives a good descriptive account of the different systems in use, of the machines and apparatus required, and of the character of the work actually done on a commercial scale by each of them. The history of the art is only lightly touched on, the detailed craftsmanship involved is not minutely dealt with, and the scientific principles are only referred to as incidental to the descriptions. But as a contemporary account of the "state of the art" in 1919, and a useful guide to the would-be user of the methods available, from which he may judge which will best suit his requirements, the book can be recommended. There is only one word of caution to be given in this connection: electric welding is an art which is undergoing rapid development, both in respect of methods and applications. Nevertheless the reader will get a very fair idea of both, and will at least be informed as to the directions in which to seek for up-to-date information.

The history of electrical welding is very well summarised in the introductory chapter, but one may supplement it by the fact that forty years ago carbon arc welding was practised by some continental firms in the burning up of accumulator sections, on erection jobs where the gas blow-pipe was not available. Arc welding and resistance welding were very nearly contemporary in their birth. Doubtless the sticking and fusing of switch contacts and similar phenomena which became unpleasantly familiar to the earliest experimentalists with strong currents from dynamos gave the idea to many of them. Elihu Thomson and Benardos are, however, identified as the effective inventors of the two processes as commercial propositions. The development of the resistance method has been one of magnitude, and specialised apparatus. The arc method made some progress in variety of application, but little else until Slavinoff substituted a metal electrode for the carbon of Benardos. Even then it took something like 20 years before the possibilities of metal arc welding were appreciated. Perhaps the necessities of war time have contributed more than any other single influence to the progress made in the use of metal arc welding. Those necessities stimulated experiment and invention, disclosing a far wider range of application and utility than had been recognised. There is every indication that this range will be much extended within a few years.

The considerable impetus to metal arc welding which has followed the introduction of flux covered electrodes is pointed out, and the views of inventors and users are fairly set out. Very wisely the author does not enter into the controversies which have arisen on this question. These controversies will be settled by practical and commercial considerations; possibly aided by disinterested research, of which, however, hardly anything seems likely to be done in this country. The Admiralty made a commencement of such research, but it was shut down soon after hostilities ceased.

Two chapters are devoted to descriptions of the principles and elementary apparatus of carbon arc and resistance welding respectively. These chapters indicate very well a fundamental difference between the arc and the resistance methods. Arc welding requires few and simple appliances, which are easily adapted to almost any kind of work. Resistance welding requires specialised tools for each kind of job, and for each magnitude of job. Arc welding is essentially a jobbing process, resistance welding essentially a manufacturing or quantity production process. This is not to say that arc welding is not suitable for manufacturing, or that resistance welding

cannot be applied to repairing and other odd jobs. But the resistance welder is essentially a machine tool with a narrowly defined range of capacity. An arc welding outfit is essentially a hand tool with a wide range of adaptability. There are differences in the character of the welds made. The resistance weld resembles closely that made by a smith, the arc weld is more correctly autogenous soldering, in which metal is added to the original material and fused into it. Arc welding, at present, is almost confined to the ferrous metals, resistance welding is applicable to almost any metal or alloy.

The work carried out by the Steel Barrel Co., of Uxbridge, has a chapter to itself. The subject is a good one, because carbon arc welding has been used at these works for more than twenty years, and more recently resistance and oxy-acetylene welding have been added for certain portions for which they are more convenient than the carbon arc. As the whole process of making a steel barrel is described, the reader will get a good idea of this manufacturing application.

The quasi-arc process, essentially a coated metal electrode method, is described in another chapter, which gives a good deal of information about the details of manipulation, electrode sizes and current strengths for various thicknesses of work, giving altogether quite a good notion of the most recent methods of arc welding. Four chapters are devoted to descriptions of machines and apparatus for arc welding. In the main, these are descriptions of the generators, motor generators, and transformers designed by various firms for the supply of energy at suitable voltages and current strengths. A number of useful portable sets are described and illustrated. As arc welding requires a lower voltage than those generally used for other purposes, and currents up to a few hundred amperes, whilst it is desirable for several reasons that the voltage shall be limited, some kind of transforming apparatus is almost essential where a supply is available on the work. Where no supply exists, evidently a portable generating set is required. It will be seen from the descriptions that these requirements can be met by a number of makers. More or less automatic regulation is provided in various ways, both for continuous and alternating current. As arc welding involves some deliberate and more or fewer accidental short circuits, such automatic regulation, or at least limitation of the current is very necessary. Practical welders seem to be coming round to the view that there is little to choose between continuous and alternating current for metal arc welding, so it is likely that converting sets will not be much in demand in future.

Perhaps the most elaborate automatic regulating arrangement in use is that of the American Plastic Arc Welding Co., in which a solenoid carrying the welding current varies the pressure on a carbon pile resistance. This is fully illustrated and described. The general reader may be more interested by the fact that this apparatus was used in repairing the damaged engines of some of the German vessels interned in American ports, and by the illustrations of such damage.

The apparatus of the American A.C. Cutting & Welding Co. also has a chapter to itself. This apparatus is a transformer with self-regulating characteristics, adaptable for various working ranges, and for connection to ordinary supply systems.

These chapters will show that a good deal of attention has been paid to the problems of energy supply for arc welding. Practically that is all the machinery there is to it. The actual welding equipment is little more than an electrode holder with a flexible lead, protective screens or hoods, gloves, &c.; a suitable connection lead and clamp for the other pole of the circuit connected to the work, and a stock of such electrodes, carbon, or metal, as the work requires.

The case is very different with resistance welding. No fewer than six chapters are devoted to resistance welding machines. It will be seen that a large variety is available, adapted to butt, spot, and seam welding for many metals and many jobs. The current strength and mechanical pressure needed to make a good weld vary with the kind of metal, its thickness, the area of the weld. The arrangements for holding and feeding the work naturally vary also with the shape of the parts and the kind of weld to be made. Necessarily, therefore, resistance welders are rarely general utility machines, even in a restricted sense. They have to be designed for their jobs, like a repetition machine tool, to which class they really belong. The six chapters mentioned illustrate and describe a very large number of such tools, they will show the would-be user either that there are machines which will do his work, or which of the designs can be most readily altered to suit him, so that he will have guidance as to where to direct his inquiries. This is perhaps the most valuable feature of the book to the manufacturer or designer of metal articles in the fabrication of which rapid and economical joining of parts is a necessary feature.

All resistance welders are operated by alternating current, and all have the transformer incorporated into the design. This is a necessary consequence of the requirements of very large currents, up to thousands of amperes, and very low voltage, never more than 4 or 5. Apart from these characteristics the designs are of illimitable variety.

The chapter on the strength of electric welds summarises the available information on this important subject. The most debatable point has been the strength of arc welds, which has been the object of a good deal of suspicion. The data given show that ample strength can be secured for most purposes. Experience on this is still accumulating with the rapid extension of the process. The skill and care of the operator are important factors, just as they are in smiths' welds, but progress is being made not only in the training of operators, but also in designing control apparatus which imposes conditions making for good work.

The book is well got up, well printed, and well illustrated, and can be confidently recommended as fulfilling its professed purpose. H. M. S.

Controllers for Electric Motors. By H. D. James, B.S., M.E. Pp. 354+xiv, 259 figs. London: Crosby Lockwood and Son. Price 21s. net.

The work is a reprint of a series of articles which have appeared in the *Electric Journal*, additional text and diagrams having been inserted where necessary. It is essentially a specialist book, and is designed to give a complete account of control possibilities for both alternating and continuous current types of motors.

Following several chapters of a preliminary nature, we first find a consideration of manually operated controllers. Comparatively little information is given regarding face plate type devices, but drum controllers are described at greater length.

The most valuable section of the book deals with automatic control in which use is made of contactors operated electrically or by other means. Great stress is laid on the necessity, in such a method of working, of closing the contactors in succession at the proper time, and a very interesting chapter discusses the methods available for effecting this operation. The succeeding chapter gives an account of a series of oscillographic records obtained in connection with this method of control, and attention is drawn to the fact that these show that comparatively few steps are really necessary in the starting resistances of small or moderate sized machines. This fact is of great practical importance, since it means that few contactors are necessary, leading to simplicity and cheapness.

The various protective devices desirable in the case of large motors, some of which are probably not well known to the average electrical engineer, are also adequately described. Special attention is devoted to series-parallel controllers for series motors, the several means available for passing from the series to the parallel position being considered at length.

The concluding chapters are devoted to a consideration of the actual arrangements commonly used in certain definite applications as mine hoists, rolling mills, machine shops, &c. These, of course, on account of the American origin of the book, may be taken as representative of practice on the other side of the Atlantic, and will be valuable for purposes of comparison to those who are familiar with methods used in this country. Certain terms, too, are introduced from time to time which will be strange to English readers, but this does not cause any difficulty, since the exact meaning is invariably carefully explained.

A very useful feature of the work is the tabulated statement of the advantages and disadvantages attached to the use of any particular appliance or method of working which invariably follows the description of the subject under consideration. A special word of praise may also be given to the numerous diagrams of controller connections which are arranged in such a manner that the mode of operation can be readily followed.

The book certainly deals with a phase of electric working in which there is a paucity of information available in a convenient form, and may be well recommended to men whose work is concerned with controllers, whether from the constructional, installation, or maintenance points of view. The mode of treatment, which is one leading quickly to the important points to be considered, will also appeal to such readers. Students taking advanced courses can also peruse the book with advantage, the most useful chapters from their point of view being those dealing with the essential principles of operation.

Calculation of Electric Conductors. By William T. Taylor. Pp. 33. London: Constable & Co., Ltd.

This work contains chiefly a description of a method of making cable calculations by means of a logarithmic chart.

The book is well printed and bound, the chart being kept in a pocket in the cover, but there are some printers' errors and omissions which should not have escaped notice, and point to rather careless reading of the proofs. For instance, in two of the four forms of working the "typical example," on page 13, errors are found which tend to shake one's faith in the whole of the book; also a very glaring omission, twice made, on page 25, is very obvious.

It is doubtful whether an engineer would prefer to use a chart of this description or not, in order to save himself a few, usually, simple calculations, and unless the chart was frequently used it would require a certain amount of study on each occasion it was required.

Certainly if the cable was an expensive one, the average engineer would make his own calculations.

The bald statement that by adding a fourth wire to a three-phase (3 wire) system the transmission capacity will be raised three-fold requires further explanation. A. J., S.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Pyrometer Outfit.

Messrs. Automatic & Electric Furnaces, 281-283, Gray's Inn Road, W.C. 1, have recently placed a new pyrometer outfit upon the market. The indicator (fig. 1) is a moving-coil instrument of the wall type, and special attention has been paid to the pivoting to obtain a minimum of friction consistent with robust construction. The case is black enamelled with nickel finish, and is of handsome appearance. Compensating leads are provided, making the cold junction the actual terminal of the instrument, which is in accordance with the most approved practice. The thermo-couples provided are of two types. The first (fig. 2) is a nichrome-nickel protected couple intended for use in salt bath and case-hardening furnaces, gas muffles, metal melting furnaces, &c. For radiation furnaces and muffles free from deleterious fumes a cheaper type of couple may be used (fig. 3). This is unprotected, and therefore much quicker in action. Both types of thermo-couple are made for working temperatures up to 1,000 deg. Centigrade.

Fig. 1.—Pyrometer Indicator.

Fig. 2.—Protected Thermo-couple.

Fig. 3.—Unprotected Thermo-couple.

The "Alco" Electric Car.

The accompanying illustration, fig. 4, shows the "Also" single-seated electric carriage, which has recently been introduced by Messrs. Arthur Lyon & Co., of 36, Victoria Street, Westminster, S.W., and which made its first public appearance at Regent's Park, N.W., in June last. The little vehicle is fitted with a body resembling that of a motor-cycle sidecar, and is equipped with a small electric motor which operates the rear wheels through a chain drive. The necessary electrical energy is supplied by two batteries carried at the sides between the wheels; they can be grouped to give either 24 or 48 volts, while they can be recharged in four groups at 12 volts. The capacity is stated to be 30 miles on one charge at an average speed of 10 miles per hour, while gradients of one in nine can, it is claimed, be mounted. The forward and reverse speeds, as also the brake, are arranged to be operated either by hand or foot. The little vehicle, which is equipped with wire wheels and pneumatic tires, is stated to weigh, complete with battery, but without passenger, 6 cwt.

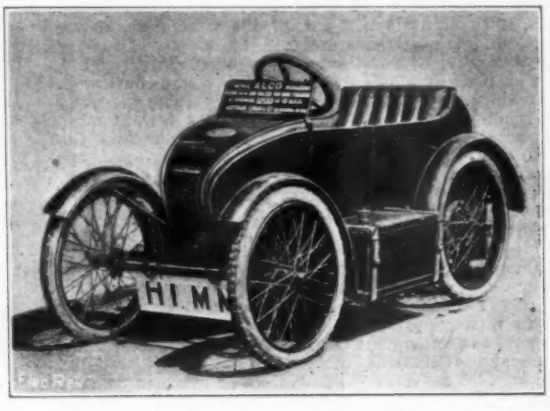


Fig. 4.—The "Alco" Electric Car.

The "Periscope" Spark Plug.

The advantages of a spark plug that would permit a view of the conditions obtaining within the cylinder while the engine was working, have long been realised. The "Periscope" plug, fig. 5, the patent rights of which are owned by the Metropolitan Laboratories, of "Elmhurst," Twickenham Park, Middlesex, embodies within a substantially designed plug all the advantages of a view plug, petrol injector, and compression release. A is the silica view lens attached to the nut B and removable for cleaning the lens or for petrol injection; C is the tubular electrode; D the sparking point, which is seen from outside the cylinder through A; E is the body; F the insulator, and G the spring. The spark can be seen under actual working conditions, and the carburation can be judged by the colour of the flame. The view lens is of heat-resisting material, and is remote from the explosion products of oil vapour, being cushioned therefrom by a column of inert gas, and, therefore, is claimed to keep clean in the dirtiest of engines. The lens and nut can be readily removed for petrol injection.

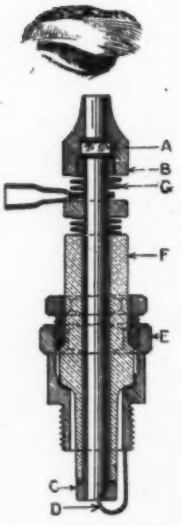


Fig. 5.—The "Periscope" Sparking Plug.

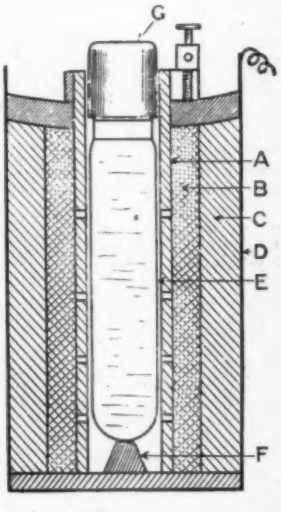


Fig. 6.—"Phœnix" Regenerative Dry Cell.

and every part of the plug is replaceable if damaged. During manufacture the plugs are tested at 300 lb. pressure for both tightness and insulation.

The "Phoenix" Regenerative Dry Cell.

Dry cells become stale, and are generally discarded, long before they are really worn out. If they could be provided with an extra supply of regenerative fluid in a convenient manner their life would be considerably prolonged at small additional cost. Particulars of a cell that fulfils these conditions have been sent us by the Metropolitan Laboratories, of "Elmhurst," Twickenham Park, Middlesex. In the "Phœnix" cell, fig. 6, A is the carbon, B the depolariser, C the paste, and D the zinc. The extra supply of regenerative fluid is contained in the glass tube E, which is fitted in the cell during manufacture. When the cell becomes weak any unskilled person can easily revive it by simply driving the plug G, which is waxed in, down until it is level with the top of the cell. The glass tube E is thus broken on the anvil F and the fluid released.

ELECTRICITY SUPPLY AT PARIS.

The Gennevilliers Super-Station.

Up till about seven years before the war, Paris was supplied with electrical energy by a number of small generating stations, owned by various companies, serving different portions of the Paris area. It was felt, however, that this arrangement had serious drawbacks, leading to the wastage both of effort and capital. In consequence, a convention was arranged in 1907, whereby the Compagnie Parisienne de Distribution d'Electricité was superseded by Secteurs, which took over the supply of electricity throughout Paris until 1924, an item of the conditions being that the Municipality shared both in the receipts and the profits. The programme of new works arranged included the installation of two new central stations, that of St. Ouen-sur-Seine to the north, and that of Issy-les-Moulineaux to the south-west of Paris. New substations and transformer stations were also planned, and the conversion of the network from two to three or five-wire, with the establishment of a new distribution service in north-eastern Paris. The system chosen was two-phase, 42 periods, A.C., at 12,300 volts. The works thus planned were carried out just before the war broke out. During the years of the war the equipment of the several stations had much deteriorated by being uninterruptedly used day and night, while large contributions for war purposes were levied on many, and the conviction was forced that capital used for the rehabilitation of these stations would be better employed in the construction of one "super-station." Hence the foundation of the Union Française d'Electricité—a company formed to carry out this idea. It has been generally recognised that the several Secteurs, if freed from the manifold costs of renovations and the care of generating their own power, may devote their efforts the more effectually to developing their respective networks and the distribution of energy. On August 25th, 1919, the Compagnie Générale de Distribution d'Energie Electrique, which owned the important Vitorz station (55,000 KW.), and the Billancourt station (22,000 KW.), amalgamated with the Union Française d'Electricité, and founded the Union d'Electricité for, specifically, the construction of the super-station at Gennevilliers, and to carry out the reorganisation programme of electricity supply in the Paris region. Some weeks later the Energie Electrique de la Région Parisienne was absorbed. This company was originally established in 1913 to supply electric power for traction purposes for the State railways, and owned works at Nanterre (22,000 KW.), and Issy-les-Moulineaux (22,000 KW.). Agreements were later made with four of the most important companies serving sections of the outskirts, namely, the Triphasé, the Ouest-Lumière, the Est-Lumière, and the Rive Gauche. Their works were sold to the Union Electricité, but are being temporarily used till the Gennevilliers super-station is completed and ready to work, when they will fall into the position of reserve plants. The following are, in round numbers, the yearly outputs of the five stations which will be superseded by the Gennevilliers station :—

(1) Energie Electrique de la Région Parisienne Company.

a. Nanterre ...	...	50,000,000 KW.-hours	... (in 1918).
b. Issy-les-Moulineaux		50,000,000 KW.-hours	... (estimated).

(2) Triphasé Company.

c. Asnières ...	...	80,000,000 KW.-hours	... (in 1918).

(3) Est-Lumière Company.

d. Alfortville...	...	35,000,000 KW.-hours	... (in 1918).

(4) Ouest-Lumière.

e. Puteaux ...	...	90,000,000 KW.-hours	... (in 1918).

The super-station at Gennevilliers is situated on a bank of the River Seine, and is linked with Paris by the Paris-Mantes-Pontoise railway, *via* Argenteuil. At the outset, the station will have an installed capacity equal to 200,000 KW., which may be increased later on to 300,000 KW. The equipment will comprise 35,000-KW. turbo-alternators; Babcock & Wilcox marine boilers, each having 1,350 sq. m. heating surface; a superheater of 552 sq. m. heating surface; a 480-tube economiser; and a 1,000 sq. m. surface air-heater. The boilers will be grouped in fours, and will be on the Prat system. Work was begun on this station at the beginning of the year, and it is expected to be out of hand by January 1st, 1922. The greater number of existing stations being available as reserves, the aggregate output of power when the Gennevilliers station is at work, will approximate to 700,000,000 KW.-hours a year.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

21,976. "Control devices for telephone services." A. J. H. Haddan (F. W. Hall). July 22nd.

22,007. "Wireless telegraphy and telephony." Marconi's Wireless Telegraph Co. (A. N. Goldsmith). July 22nd.

22,018. "Electric signalling devices for road vehicles." P. C. Middleton. July 22nd.

22,039. "Rotary discharges for radio telegraphy, &c." D. G. Morris. July 23rd.

22,065. "Electric storage batteries, &c." I. E. Kohlmeyer. July 23rd.

22,076. "Protecting casings for transformers in induction furnaces." W. Grundhofer. July 23rd.

22,077. "Voltage regulators for electric current generators." Scintilla. July 23rd. (Switzerland, August 8th, 1919.)

22,084. "Electric current regulating devices." W. H. Glaser. July 23rd.

22,106. "Electric switches." A. Stringer. July 24th.

22,120. "Conveying electric current to movable truck, &c." H. Huartson and H. R. Lamb. July 24th.

22,131. "Dynamo electric machines." R. L. Cleaver. July 24th.

22,154. "Electric junction boxes, &c." H. E. Walker. July 24th.

22,168. "Electrical accommodation indicator for theatres, &c." P. A. Tillinghast. July 24th.

22,172. "Sparking plugs." F. Kay and N. Kay. July 26th.

22,180. "Electric bell." F. Thompson. July 26th.

22,189. "Electric tumbler, &c., switches." J. A. Crabtree. July 26th.

22,204. "Sparking plugs." H. V. Chandler and H. G. Dashwood. July 26th.

22,215. "Electro-magnetic telephone receivers." H. G. Shrivell. July 26th.

22,231. "Receiving signals by wireless telegraphy." Hall Research Corporation. July 26th. (United States, August 13th, 1919.)

22,237/8. "Electric discharge gap apparatus." Metropolitan-Vickers Electrical Co. July 26th. (United States, August 15th, 1919.)

22,244. "Electrolysis." M. A. Adam. July 26th.

22,245. "Electrolysis." M. A. Adam, J. Fieldhouse and J. Stevenson. July 26th.

22,258. "Telephone receivers." Siemens & Halske Akt.-Ges. July 26th. (Germany, July 24th, 1919.)

22,259. "Sparking plugs." M. P. Seneze. July 26th. (Belgium, October 8th, 1919.)

22,260. "Apparatus for production by electrolysis of gas under pressure." E. Vesme. July 26th.

22,275. "Apparatus for electric welding." T. Waddington. July 26th.

22,295. "Switchgear for controlling supply of electricity to machinery, &c." W. de Renzi. July 27th.

22,296. "Balanced electrical relays." C. C. Garrard, A. H. Railing, and W. Wilson. July 27th.

22,313. "Means for electrically driving bowls of centrifugal separators." A. Melotte. July 27th. (Belgium, December 26th, 1919.)

22,328. "Signalling devices, &c." A. L. Davis and A. K. T. Smith. July 27th.

22,346. "Sparking plugs." A. E. Heath. July 27th.

22,358. "Dynamo-electric machines." W. F. Higgs. July 27th.

22,359. "Alternating-current meters." Dr. P. Meyer Akt.-Ges. July 27th. (Germany, January 27th.)

22,369. "Electric motor starting device for internal-combustion engines." R. Bosch Akt.-Ges. July 27th. (Germany, September 22nd, 1919.)

22,383. "Electric light sconce fittings." S. W. Hamlyn. July 27th.

22,384. "Switch control devices." A. A. Lippold. July 27th.

22,390. "Alternating current electric motors." Carey-Gavey Syndicate. July 27th.

22,439. "Trolleys of overhead electric cables." J. W. Player. July 28th.

22,440. "Electric lamp supports." A. C. Runkel. July 28th.

22,448. "Terminals for electric conductors." G. H. Sykes. July 28th.

22,456. "Mounting of electric motors." C. F. Barnholdt. July 28th.

22,458. "Electric controlling devices." British Thomson-Houston Co. and V. E. Hall. July 28th.

22,472. "Process for protecting apparatus against electrolytic destruction." F. von Wurstemburger. July 28th. (Switzerland, August 2nd, 1919.)

22,484. "Electrical chain welding machine." Union. July 28th. (Switzerland, September 2nd, 1919.)

22,508. "Electro-magnetic reception arrangements." F. J. Chambers. July 29th.

22,527. "Multi-electrode valves, &c." S. R. Mullard. July 29th.

22,547. "Regulation of electric currents." W. Langdon-Davies and A. Soames. July 29th.

22,563. "Electro-magnetically-operated controlling devices." Cutler-Hammer Manufacturing Co. and Igranic Electric Co. July 29th.

22,607. "Alternating-current induction motors." E. S. Carey. July 29th.

22,617. "Long-distance power transmission." A. M. Taylor. July 29th.

22,669. "Electric stop motions." A. Roberts. July 30th.

22,673. "Electrical current plugs, &c." W. de Renzi. July 30th.

22,685. "Method of measuring lengths of electric waves." P. J. & S. M. T. Armagnat and Veuve C. M. A. de Nerbonne. July 30th.

22,703. "Reception of wireless signals." H. J. Round. July 30th.

22,727. "Overload cut-out with power storage." F. Krupp Akt.-Ges. July 30th. (Germany, August 7th, 1919.)

22,732. "Electric switches and switch-holders." H. Garde. July 30th.

22,761. "Synchronous motor for polyphase current." Maschinenfabrik Oerlikon. July 30th. (Switzerland, August 26th, 1919.)

22,797. "Electrical device for withdrawing metal splinters from the eye." A. Gatti. July 31st.

22,805. "Dynamo-electric machinery." D. F. Alexander, W. Hunter, and R. Kerr. July 31st.

22,817. "Electrically-operated safety device for automatically stopping machinery." R. H. Darry. July 31st.

22,819. "Rotary electric machines." K. Nobuhara. July 31st.
22,823. "Recording dynamometers." M. Rockstroh. July 31st. (Germany, August 4th, 1919.)
22,828. "Transmitting photographs, &c., by telephone or wireless telephony." F. Wyndham. July 31st.
22,874. "Electric switches." R. A. R. Bolton. August 3rd.
22,892. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. August 3rd.
22,901. "Radio-communication systems." G. O. Squier. August 3rd. (U.S., August 3rd, 1919.)
22,932. "Electrical heating-units for heating apparatus, &c." F. Husband. August 3rd.
22,941. "Thermionic valves." H. Morris-Airey, A. K. Macrorie, and S. R. Mullard. August 3rd.
22,942. "Thermionic valves." T. E. Goldup, A. K. Macrorie and S. R. Mullard. August 3rd.
22,943. "Thermionic valves." A. K. Macrorie, S. R. Mullard and G. Shearing. August 3rd.
22,950. "Ships' telegraphic apparatus." C. A. Mosedale and G. Taylor. August 4th.
22,973. "Process for utilising mica for electrical purposes." Rai Sahib S. Mull. August 4th.
22,980. "Electrode and electrolytic batteries." A. E. Alexander (Stuart Electrolytic Cells Inc.). August 4th.
22,996. "Portable telephones for the deaf." W. Burkinshaw. August 4th.
23,007. "Magneto-electric machines." British Thomson-Houston Co., H. W. H. Warren and A. P. Young. August 4th.
23,030. "Electric welding machines." J. Y. Johnson and United States Chain & Forging Co. August 4th.
23,045. "Electrical rectifying apparatus, &c." W. H. Glaser and W. H. Glaser, Ltd. August 4th.
23,090. "Electric emergency lighting installations." P. Das. August 5th.
23,092. "Electric switches." F. W. Easter. August 5th.
23,103. "Induction motors." British Thomson-Houston Co. and General Electric Co. August 5th.
23,109. "Continuous wave telephony and telegraphy." C. S. Franklin. August 5th.
23,115. "Manufacture of electric rotating machines." T. Tanaka. August 5th. (Japan, July 11th, 1919.)
23,123. "Dynamo-electric machines." F. Creedy. August 5th.
23,126. "Sparking plugs." L. Grillette. August 6th.
23,142. "Electrical transmission of power." R. L. Aspden and F. H. Bowman. August 6th.
23,143. "Electric incandescent lamps, &c." U. Cristofoletti and N. Manetti. August 6th.
23,176. "Apparatus for starting single-armature converters from alternating-current side." Akt. Ges. Brown, Boveri et Cie. August 6th. (Switzerland, August 16th, 1919.)
23,181. "Electric vehicle controllers." G. L. Meyfarth. August 6th. (Switzerland, August 18th, 1919.)
23,182. "Ignition magnetos for internal-combustion engines." Fabriques des Montres Zenith successeur de Fabriques des Montres Zenith G. Favre-Jacot et Cie. August 6th. (Switzerland, August 26th, 1919.)
23,183. "Magnetos having rotating armatures." Fabriques des Montres Zenith successeur de Fabriques des Montres Zenith G. Favre-Jacot et Cie. August 6th. (Switzerland, November 6th, 1919.)
23,185. "Instrument for converting wireless direction-finder bearings into mercator bearings." R. E. Carey. August 6th.
23,187. "Means for securing metal, &c., bodies to insulating, &c., material." Crompton & Co. and W. F. Jones. August 6th.
23,201. "Electrically treating foods, &c." F. S. Smith. August 6th.
23,249. "Automatic electric indicator for motor vehicles." T. W. Bennett. August 7th.
23,252. "Handle, &c., for electrodes used in welding, cutting, &c." P. Buckley and Buckley, Saunders & Co. August 7th.
23,267. "Electrical connecting and supporting devices." Electric Outlet Co. August 7th. (United States, January 10th.)
23,268. "Electrical connecting and supporting devices." Electric Outlet Co. August 7th. (United States, April 9th.)
23,282. "Electric switches." R. C. S. Jamie. August 9th.
23,288. "Electric door-bells." R. L. Irvine. August 9th.
23,308. "Electric lighting systems." C.L.I. Manufacturing Co. and E. A. Watson. August 9th.
23,309. "Trolley-heads for electrically-driven vehicles." G. H. Donovan. August 9th.
23,329. "Electrical resistances." W. Clark and Clark's Neo Electric Devices, Ltd. August 9th.
23,333. "Ignition magnetos." M-L. Magneto-Syndicate and E. A. Watson. August 9th.
23,337. "Electric radiators." E. C. R. Marks (Landers, Frary & Clark). August 9th.
23,338. "Headlights and electric bulbs therefor." J. M. Richardson. August 9th. (United States, August 28th, 1919.)
23,347. "Receiving methods of radio-telegraphic and radio-telephonic signals." C. Bardeloni. August 9th. (Italy, January 10th, 1918.)
23,368. "Means for interrupting electric currents." J. A. Slee. August 9th.
23,373. "Gas exits for galvanic batteries." G. Oldham, J. Oldham and O. Oldham, and Oldham & Sons. August 9th.
23,374. "Miners' safety, &c., electric lamps." G. Oldham, J. Oldham and O. Oldham, and Oldham & Sons. August 9th.
23,375. "Electric motor for driving phonographs, &c." H. Wade (Mills). August 9th.
23,391. "Modulation systems, &c., in radio-communication, &c." Radio Communication Co. and J. Scott-Taggart. August 10th.
23,427. "Electric luminous-writing machines." F. Silbermann. August 10th.
23,442. "Telephone systems." Western Electric Co. (Western Electric Co.). August 10th.
23,450. "Electrical couplings." W. C. Lee. August 10th.
23,461. "Electrostatic igniter." H. Kuhner. August 10th.
23,470. "Electrical apparatus." E. L. W. Byrne. August 11th.
23,479. "Electric arc lamps." A. E. Angold and A. H. Railing. August 11th.
23,480. "Means for charging electric accumulators." A. E. Angold and A. H. Railing. August 11th.
23,529. "Safety apparatus for preventing overheating of electric irons." T. Klotzlo & Sohn. August 11th. (Switzerland, August 11th, 1919.)
23,535. "Electrical converter or generator." T. G. Wright. August 11th.
23,536. "Magnetic blow-out devices." V. Breeze and A. West & Co. August 11th.
23,537. "Electric furnaces." E. P. Barfield and L. W. Wild. August 11th.
23,540. "Systems of electric ship propulsion." British Thomson-Houston Co. and J. Martin. August 11th.
23,541. "Electric resistance devices." British Thomson-Houston Co. (General Electric Co.). August 11th.
23,544. "Drums for automatically coiling loose portions of electric cables." W. E. Lawton and H. Marryat. August 11th.
23,565. "Transmitting and receiving circuits for wireless telegraphy." H. Morris-Airey and A. K. Macrorie. August 11th.
23,583. "Power for driving dynamos, &c., on vessels." J. Jones. August 12th.
23,603. "Dynamo-electric machines." J. E. Calverley and W. E. Highfield. August 12th.
23,607. "Sparking plugs." P. Chaliis. August 12th.
23,610. "Methods of protecting electrical apparatus and distribution systems." British Thomson-Houston Co., H. Trencham and J. M. Wallace. August 12th.
23,645. "Electric bells." F. G. Bell, W. C. Davey and Sterling Telephone & Electric Co. August 12th.
23,650. "Electric-current regulating devices." W. H. Glaser and W. H. Glaser, Ltd. August 12th.
23,651. "Renewal of thermionic valves or amplifiers." F. Harrison. August 12th.
23,658. "Lighting and signalling device for automobiles." G. H. Allton. August 13th.
23,664. "Apparatus for measuring maximum demand from electricity supply." O. Howarth. August 13th.
23,693. "Alternating current electro-magnetic engine." V. J. C. Payne. August 13th.
23,696. "Cooling arrangement for electric machinery." Siemens-Schuckertwerke Ges. August 13th. (Germany, October 8th, 1919.)
23,727. "Determining transmission equivalent of an electrical circuit." Western Electric Co. (Western Electric Co.). August 13th.
23,740. "Brush-holders for dynamo-electric machines." W. R. Hopper and A. R. Woods. August 13th.
23,750. "Pouring-channels for electric, &c., furnaces." D. de Luca. August 13th.
23,761. "Armatures for dynamo-electric machines, &c." E. S. Banks. August 14th.
23,783. "Means for testing and remagnetising internal-combustion engine ignition apparatus." A. C. Pritchard. August 14th.
23,794. "Alternating-current motors, &c." E. S. Carey and Carey-Gavey Syndicate. August 14th.
23,798. "Dynamo-electric machines." Soc. Anon pour l'Exploitation des Procedes M. Leblanc-Vickers (formerly Soc. Anon pour l'Exploitation des Procedes Westinghouse-Leblanc). August 14th. (France, September 18th, 1919.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

6,600. "Apparatus for forming filaments for electric lamps." British Thomson-Houston Co. (General Electric Co.). (147,955.)

1919.

9,966. "Magneto-electric machines for engine ignition purposes." H. A. Sheppard. April 22nd, 1919. May 9th, 1917. (147,981.)
9,967. "Construction of electric generators and motors for working under water or other liquid." C. H. Hall. April 22nd, 1919. (147,982.)
10,130. "Electric furnaces." A. M. Teixeira. April 23rd, 1919. (147,988.)
10,248. "Electric cells for miners' lamps and for similar purposes." Haslam & Stretton and T. Stretton. April 24th, 1919. (147,994.)
10,273. "Automatic apparatus driven by electric motor for winding spring-driven clocks." F. Guye, L. H. Borel and H. Ramseyer. April 24th, 1919. (147,997.)
11,115. "Electric switches." G. Wightwick. May 3rd, 1919. (148,006.)
11,348. "Electrical water-heating elements." J. F. Barr. May 7th, 1919. (148,009.)
11,551. "Electric lamps for miners." E. Lemaire. May 8th, 1919. (148,012.)
22,913. "Galvanic cells." Firm of J. Kremenezky and K. Dukes. July 18th, 1918. (132,803.)
28,678. "Electric switches." W. E. Barber. November 19th, 1919. (148,086.)
31,908. "Electrolytic apparatus for the direct production of hypochlorites." P. Pestalozza. December 19th, 1919. (148,095.)

Standardisation in Australia.—The Institute of Science and Industry of the Commonwealth has drawn up a scheme for the creation of an Australian Engineering Standards Association. This has been agreed to by the engineering societies, and a recommendation has been made to the Commonwealth Government for the establishment of a standards association. In the meantime the question of reducing the number of structural steel sections used in Australia, and of standardising the steel used for these sections, has received attention. The annual consumption of steel and steel products in the Commonwealth is between 700,000 and 800,000 tons, while of that quantity only 200,000 to 250,000 tons are produced locally. This is the beginning of a definite attempt on the part of the Institute of Science and Industry to attack the general question of standardisation of Australian engineering materials and processes. Already considerable progress has been made with electrical standardisation, and conferences will shortly be held to deal with railway and tramway rails and fishplates. The Institute of Science and Industry of the Commonwealth will afford assistance in carrying out any investigations required, and also in supplying funds for such work as might be required in deciding on standards. With the permission of the British Engineering Standards Association, the Federal Government has reproduced illustrations of the various sections, and they are being circulated for the use of all interested in building and constructional work. Accompanying the illustrations are full specifications, to be known as "The Australian Standard Specification for Structural Steel."